CPC Forecast Products and Recent Verification

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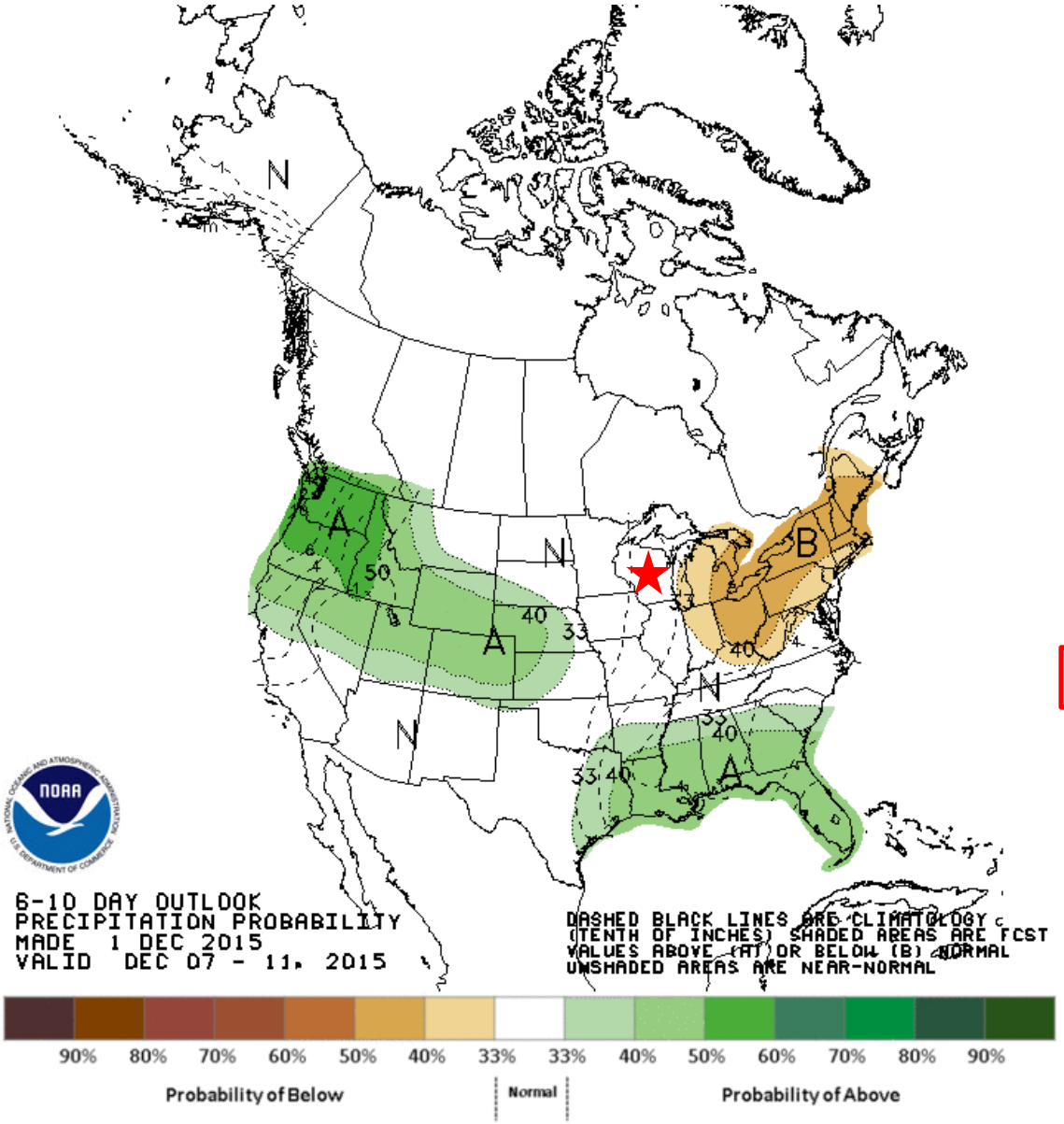
National Climate Services Meeting
College Park, MD

May 12, 2016

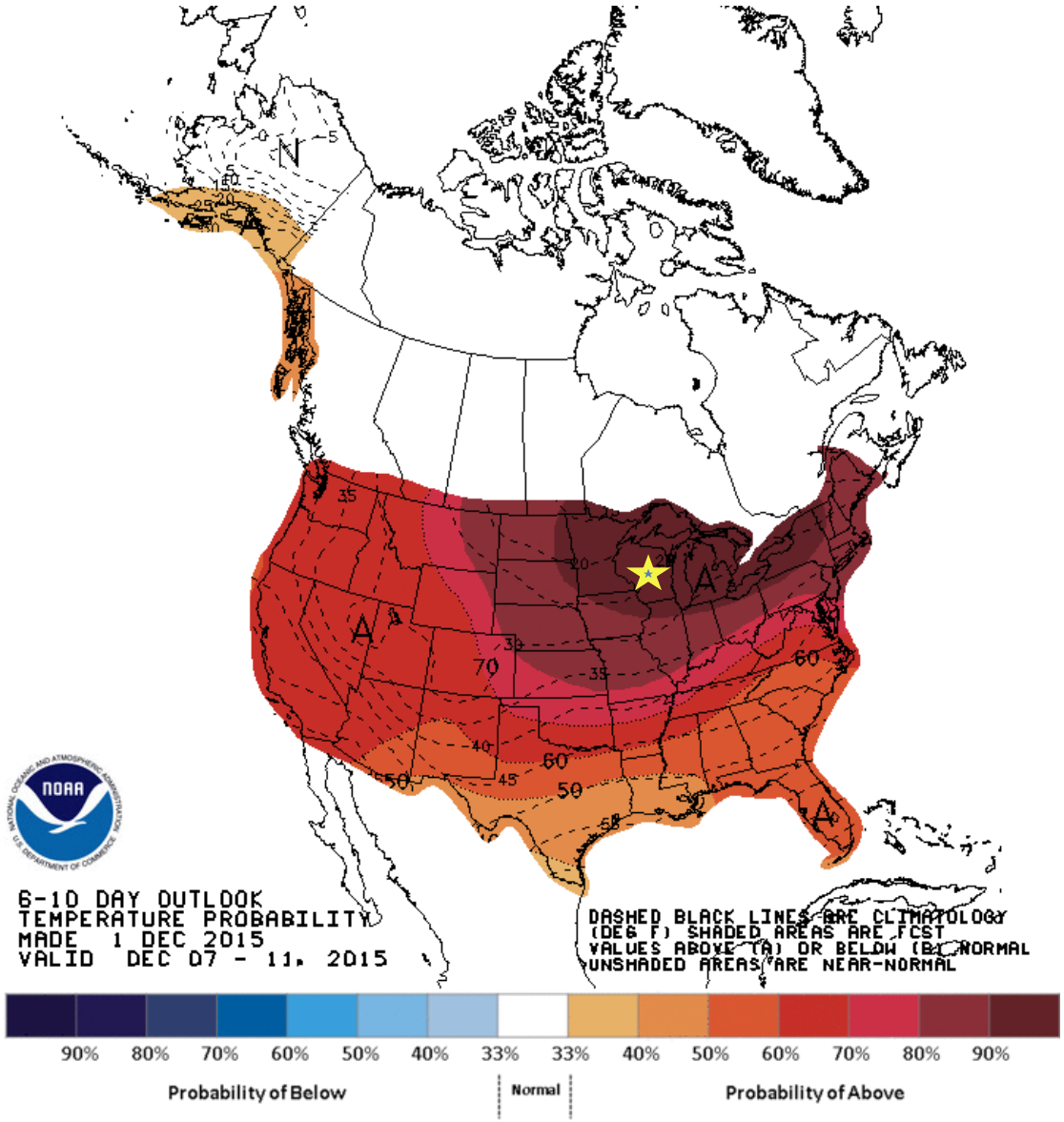
Outlook Interpretation

tiny.cc/pi-survey



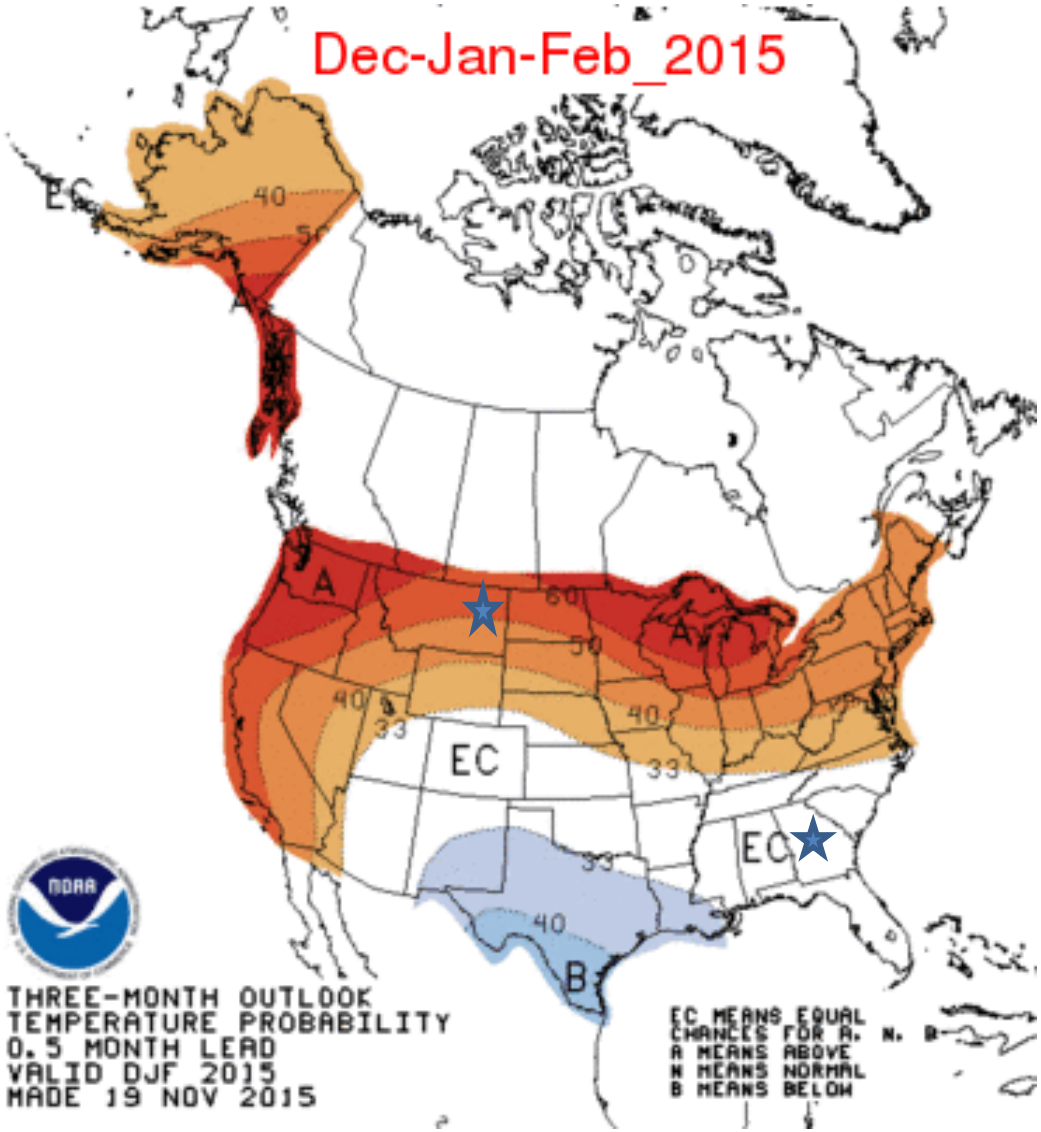
What is the correct interpretation of the 6-10 day precipitation outlook for Central Wisconsin?

33% above, 33% near, 33% below
30% above, 40% near, 30% below
25% above, 50% near, 25% below
32% above, 36% near, 32% below



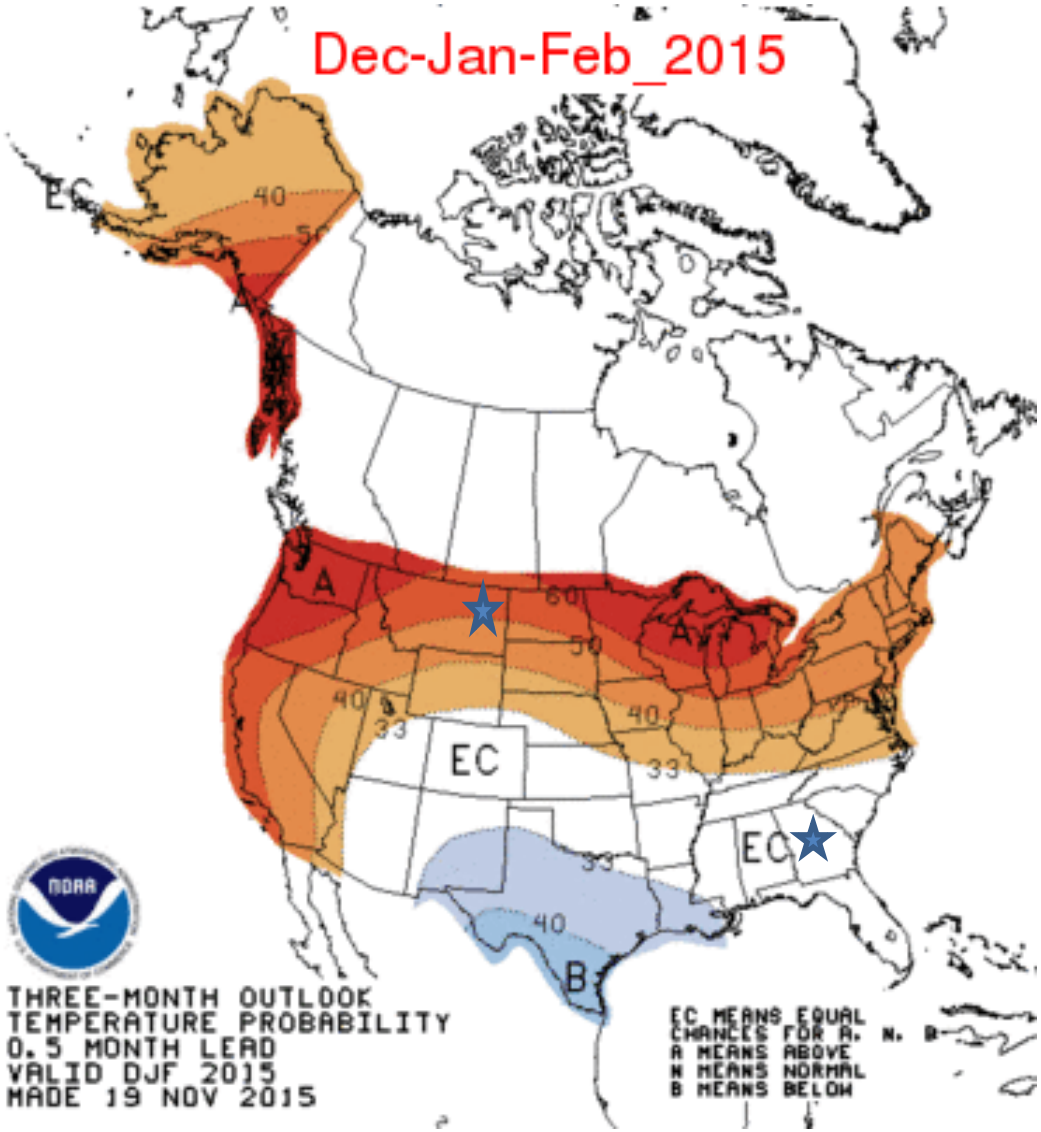
What is the correct interpretation of the 6-10 day temperature outlook for Central Wisconsin?

100% above, 0% near, 0% below
50% above, 33% near, 17% below
92% above, 5% near, 3% below
92% above, 8% near, 0% below



What is the correct interpretation of the seasonal temperature outlook for Eastern Montana?

50% above, 33% near, 17% below
50% above, 30% near, 20% below
50% above, 50% near, 0% below
50% above, 25% near, 25% below



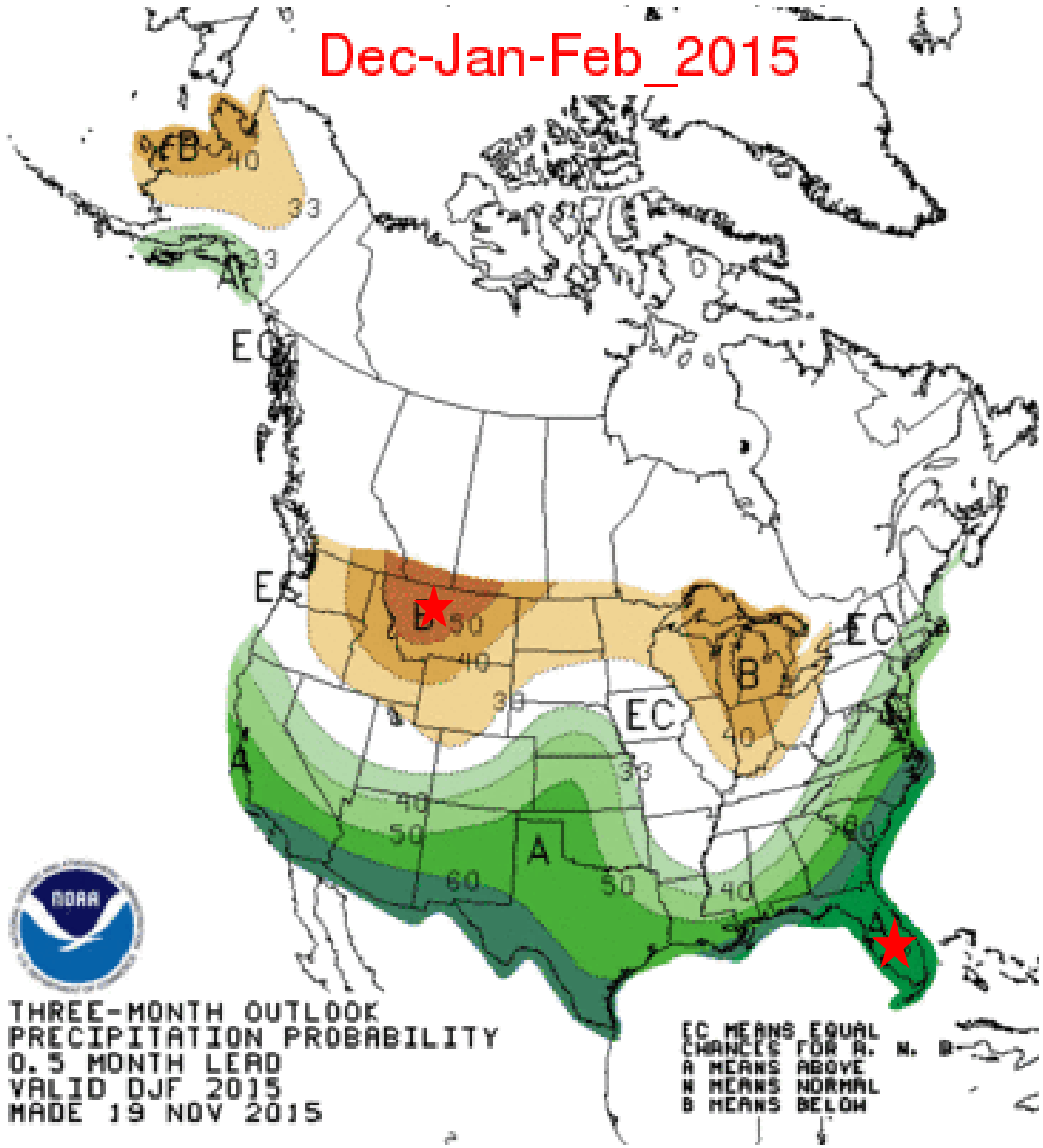
What is the correct interpretation of the seasonal temperature outlook in Georgia?

50% above, 0% near, 50% below

33% above, 33% near, 33% below

Indeterminate

25% above, 50% near, 25% below



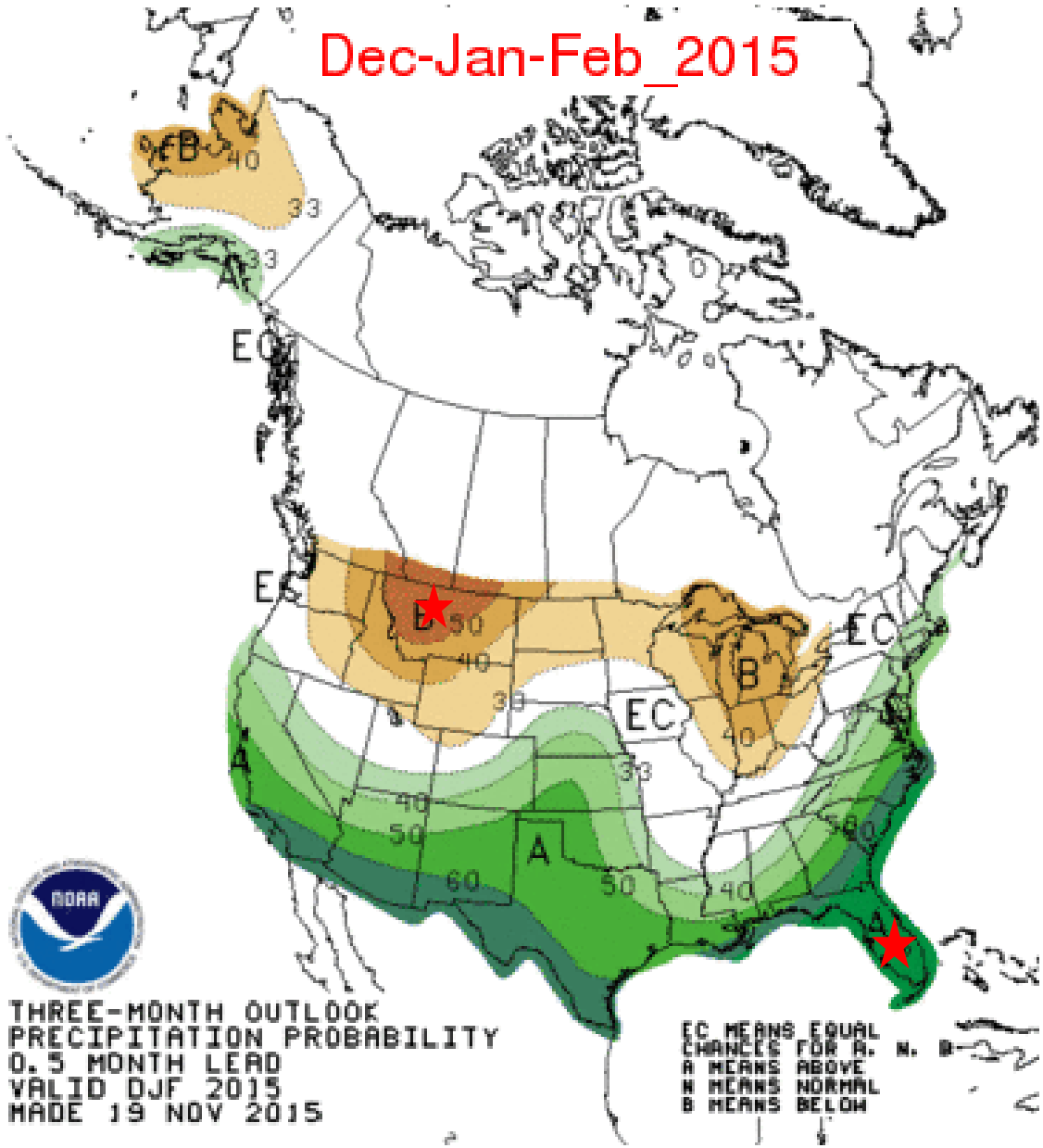
What is the correct interpretation of the seasonal precipitation outlook in western Montana?

52% above, 33 near, 15% below

15% above, 33% near, 52% below

24% above, 24% near, 52% below

3% above, 45% near, 52% below



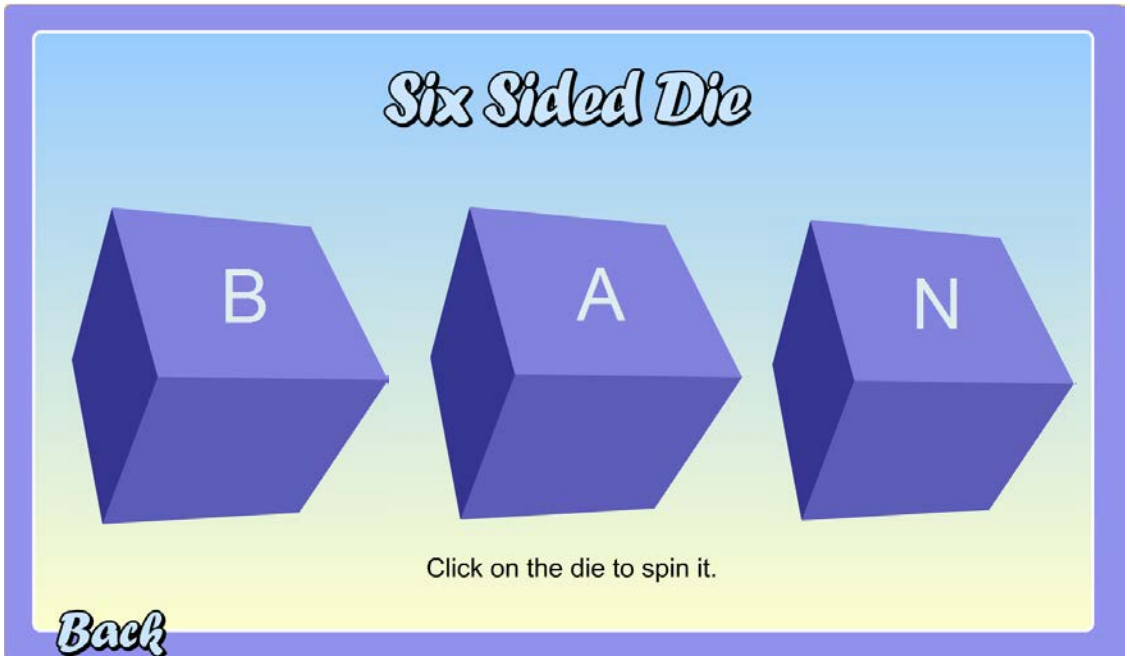
What is the correct interpretation of the seasonal precipitation outlook in southern Florida?

90% above, 7% near, 3% below
75% above, 25% near, 0% below
75% above, 22% near, 3% below
75% above, 12.5% near, 12.5% below

Equal Chances or Near-Average

Question: Why does CPC still insist on using equal chances on products even though the public, most media and even some meteorologists don't get it?

What would be so harmful in saying "near normal" on an outlook?



Consider a 6-sided Die

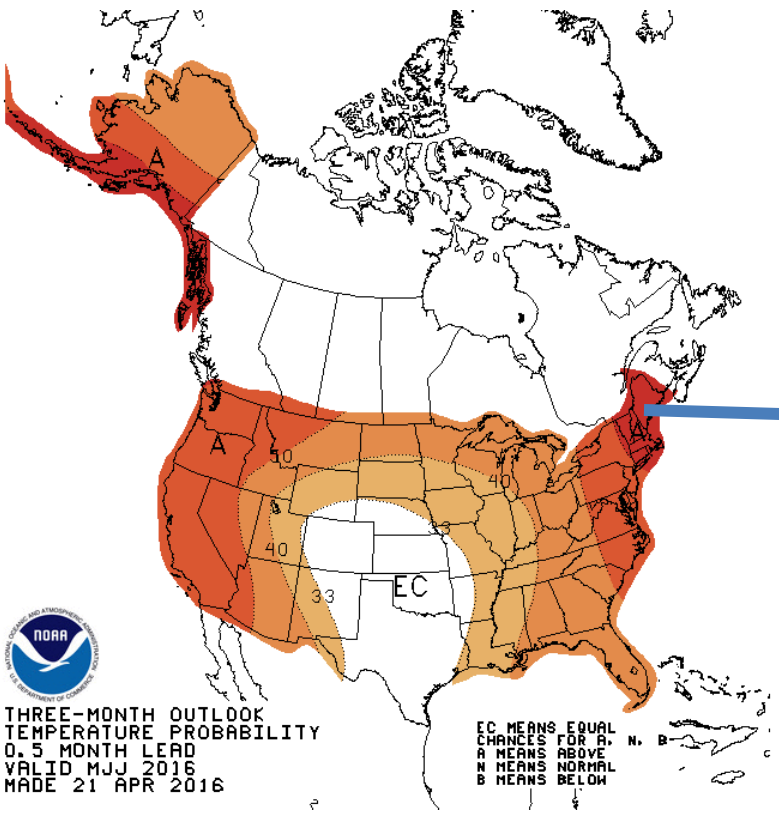
2 "A"s
2 "N"s
2 "B"s

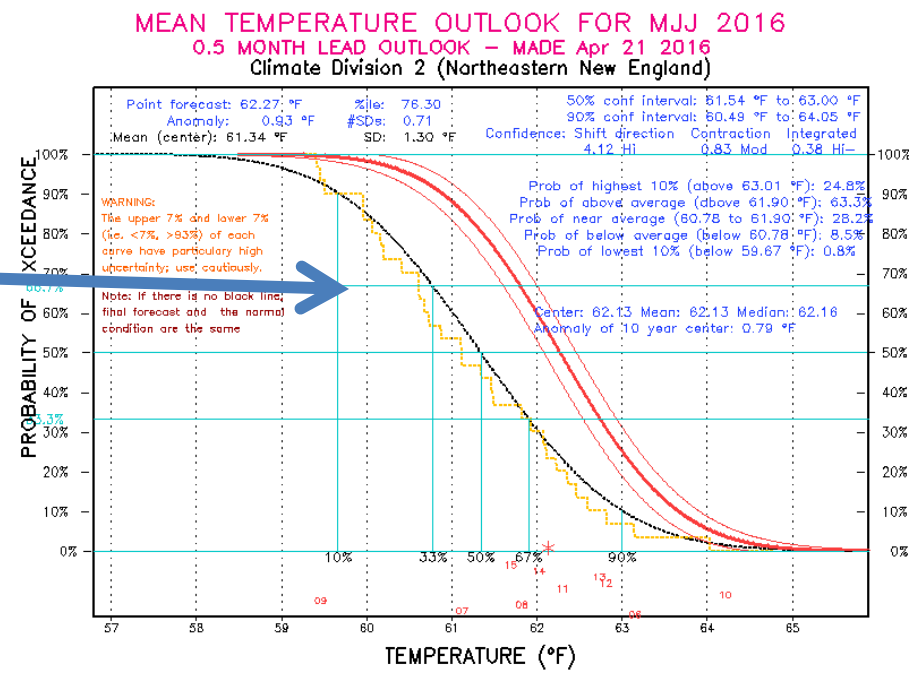
Die Demo

http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks1/maths/dice/index.htm

Probability of Exceedence (POE)

Likelihood of being greater than a value (mean temperature or precipitation amount)





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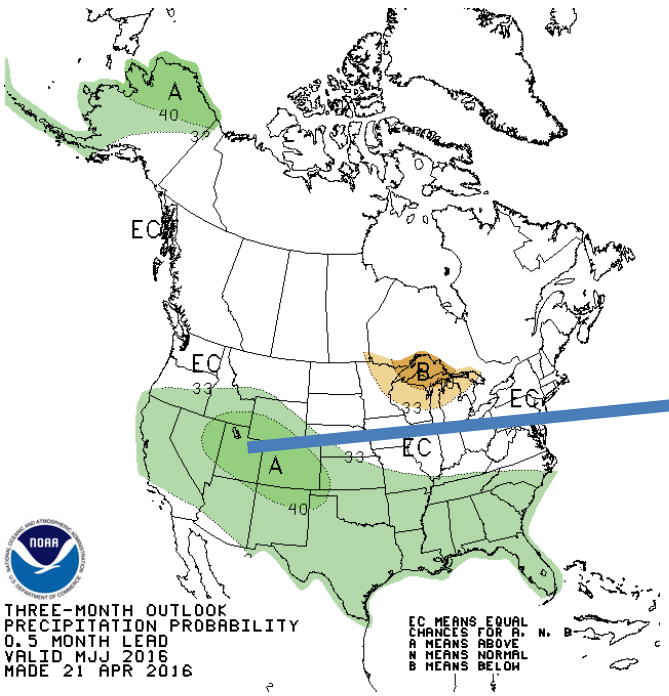
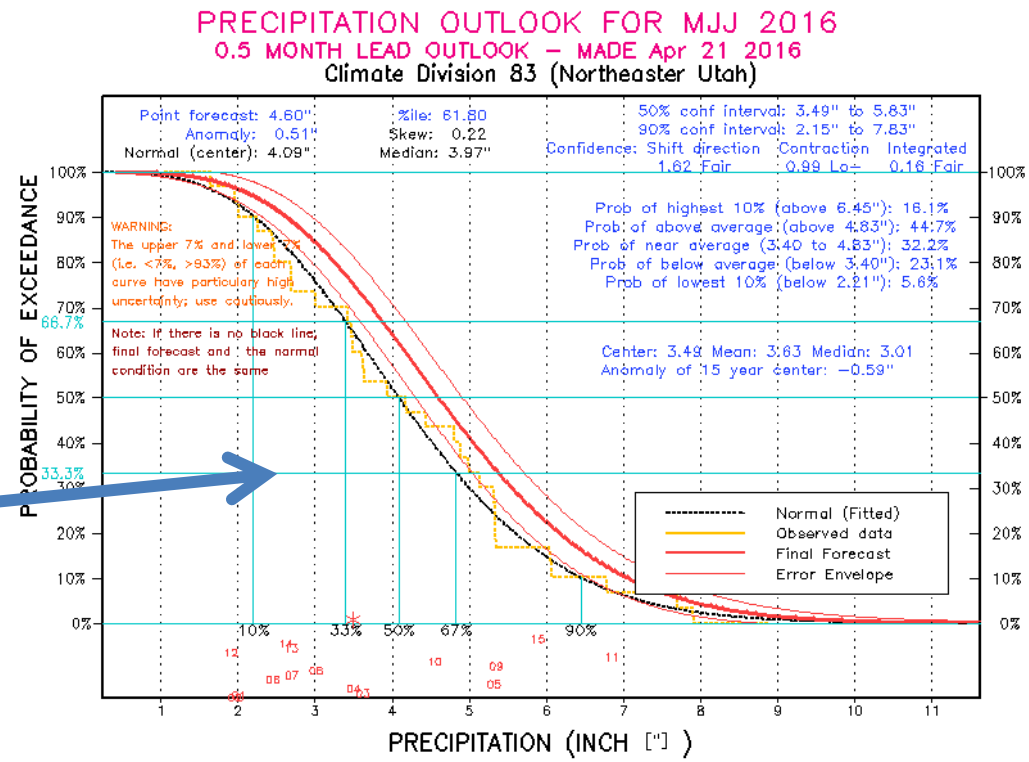
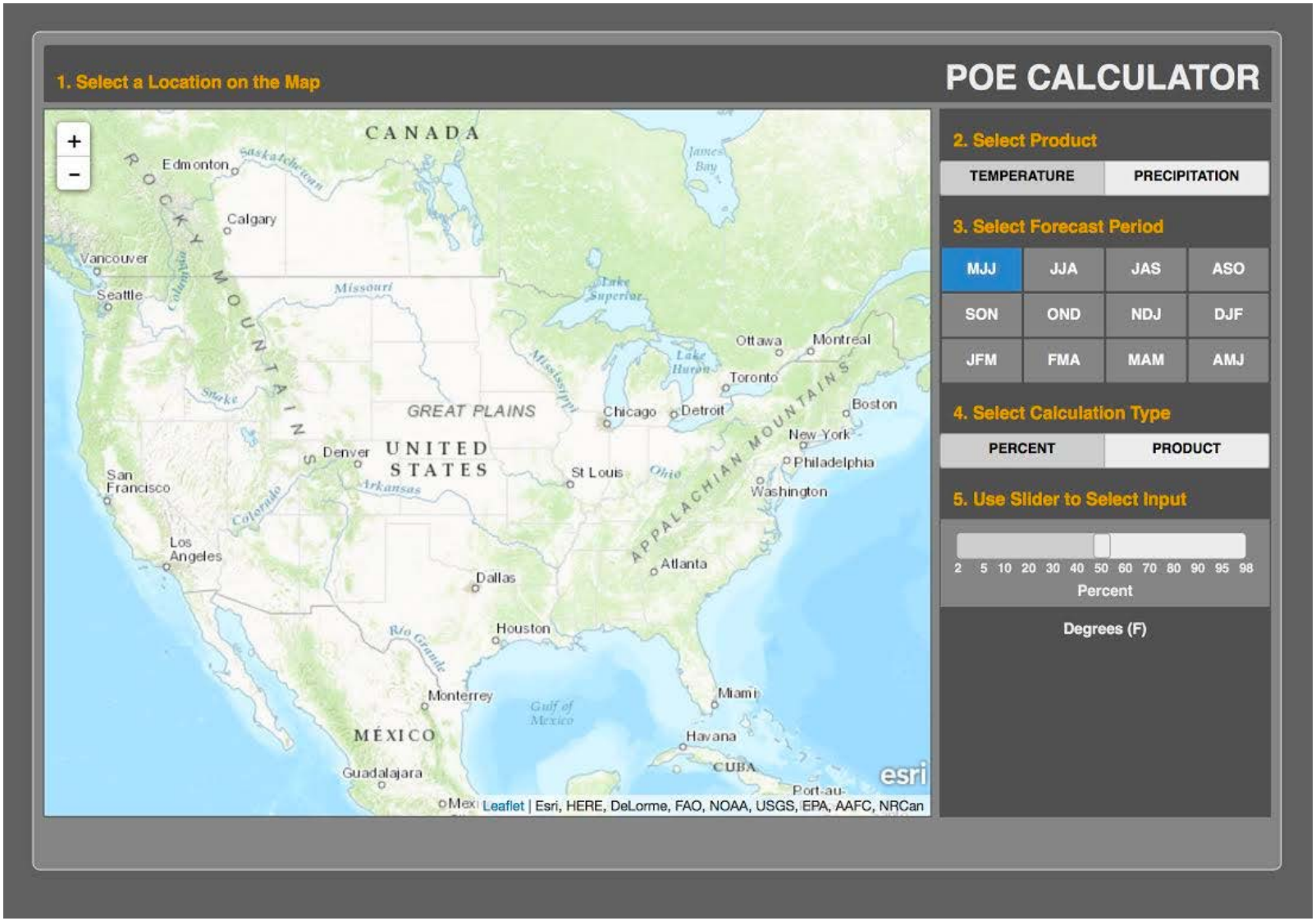
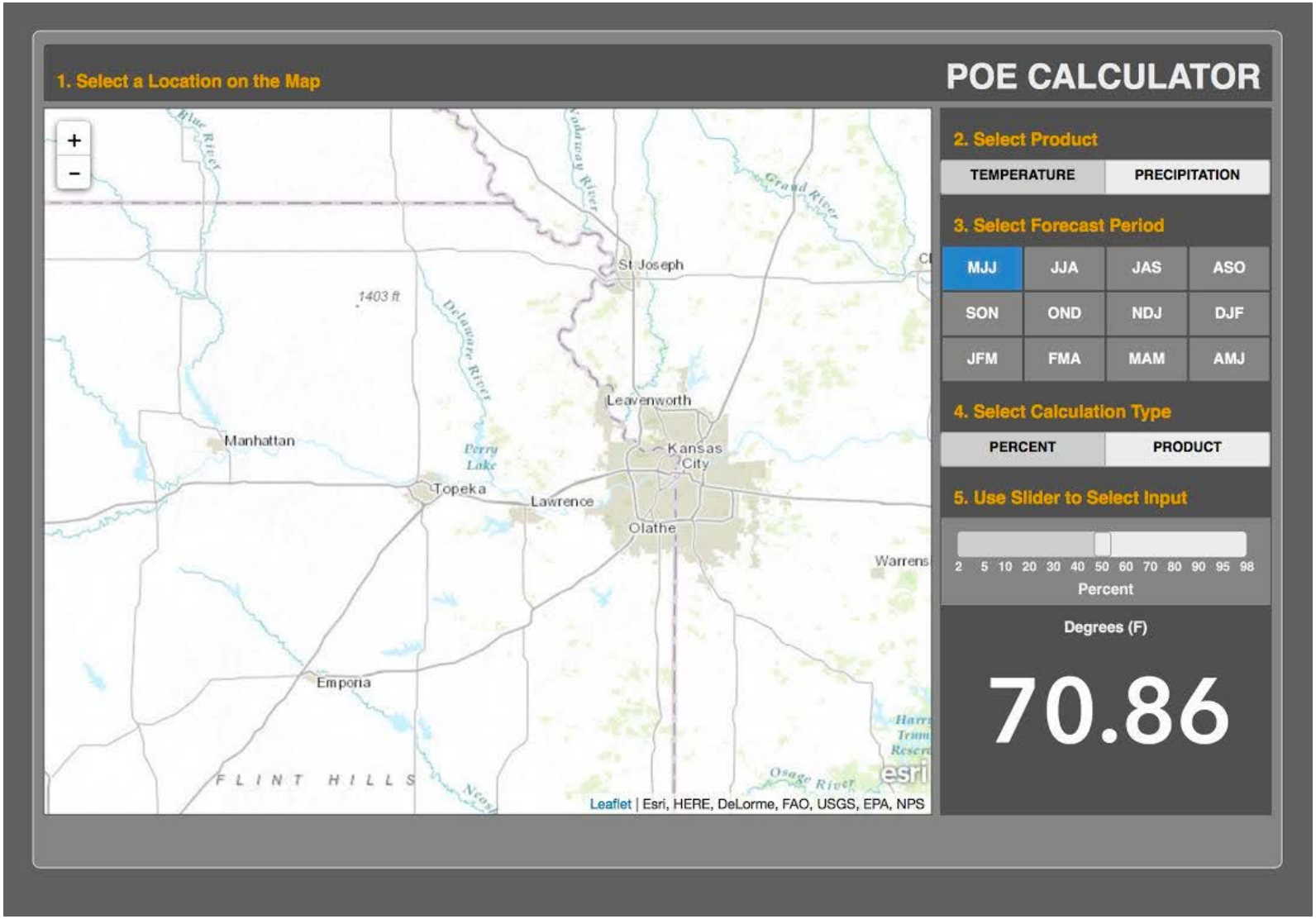




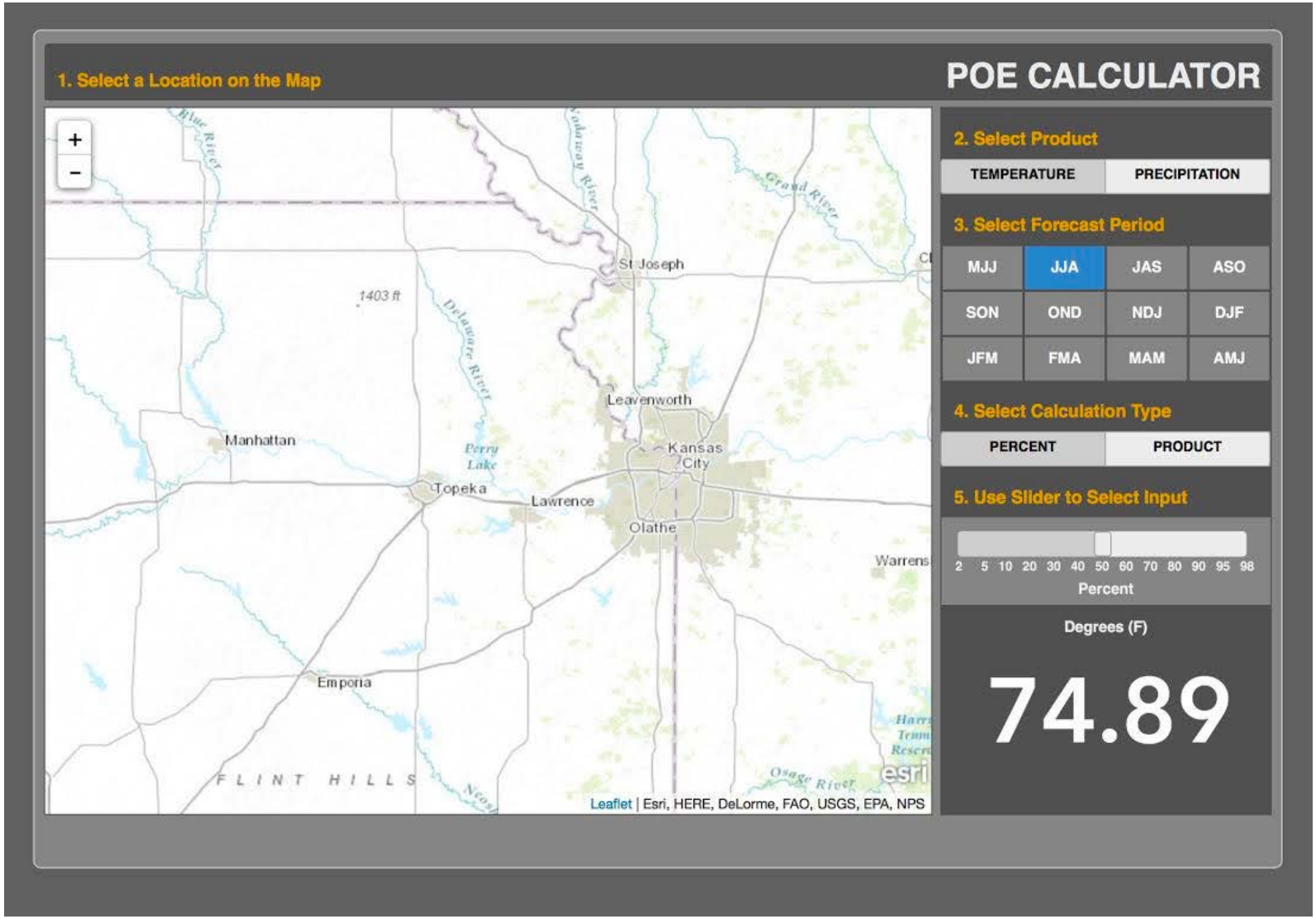
New POE Display



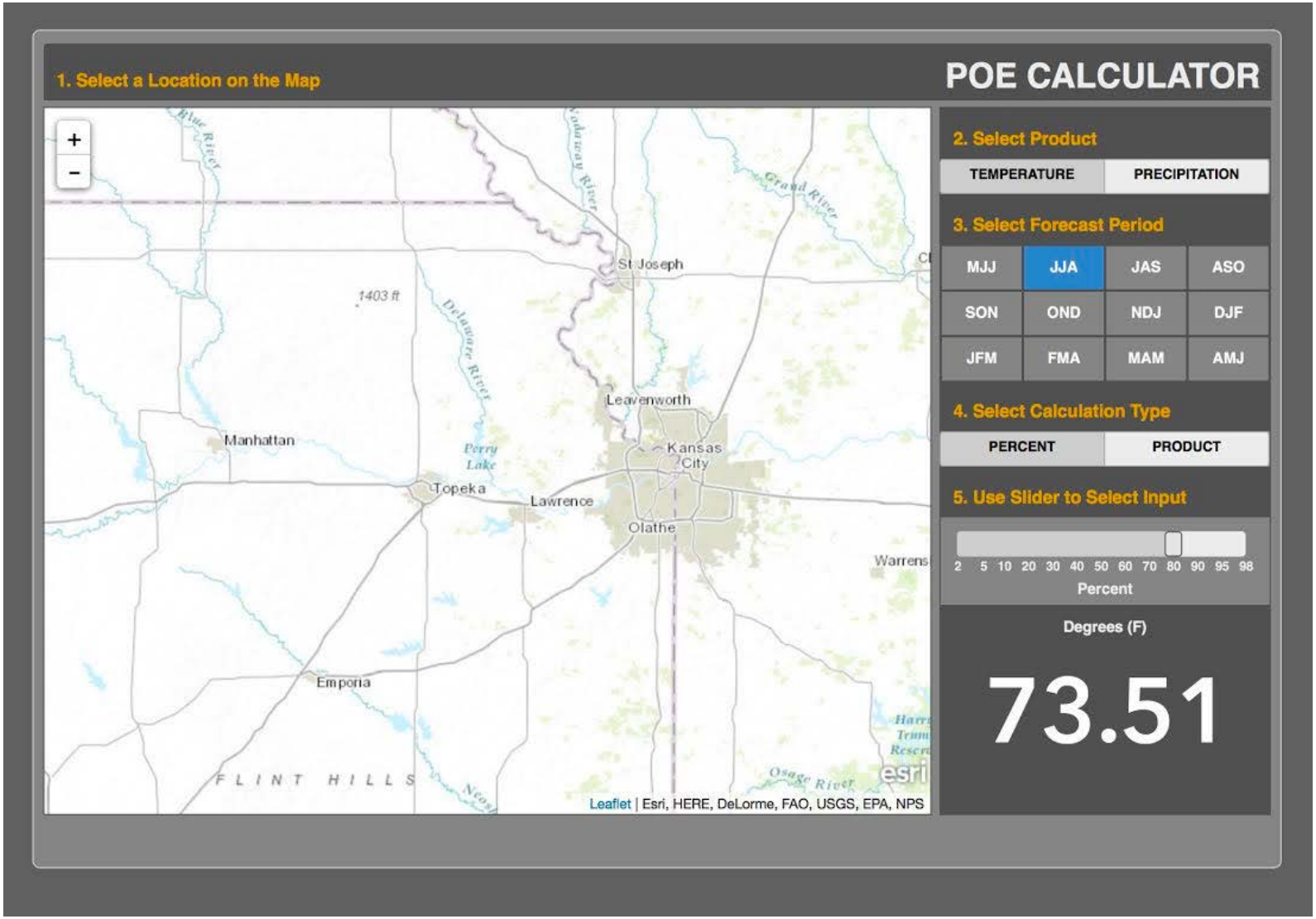
POE Calculator



POE Calculator



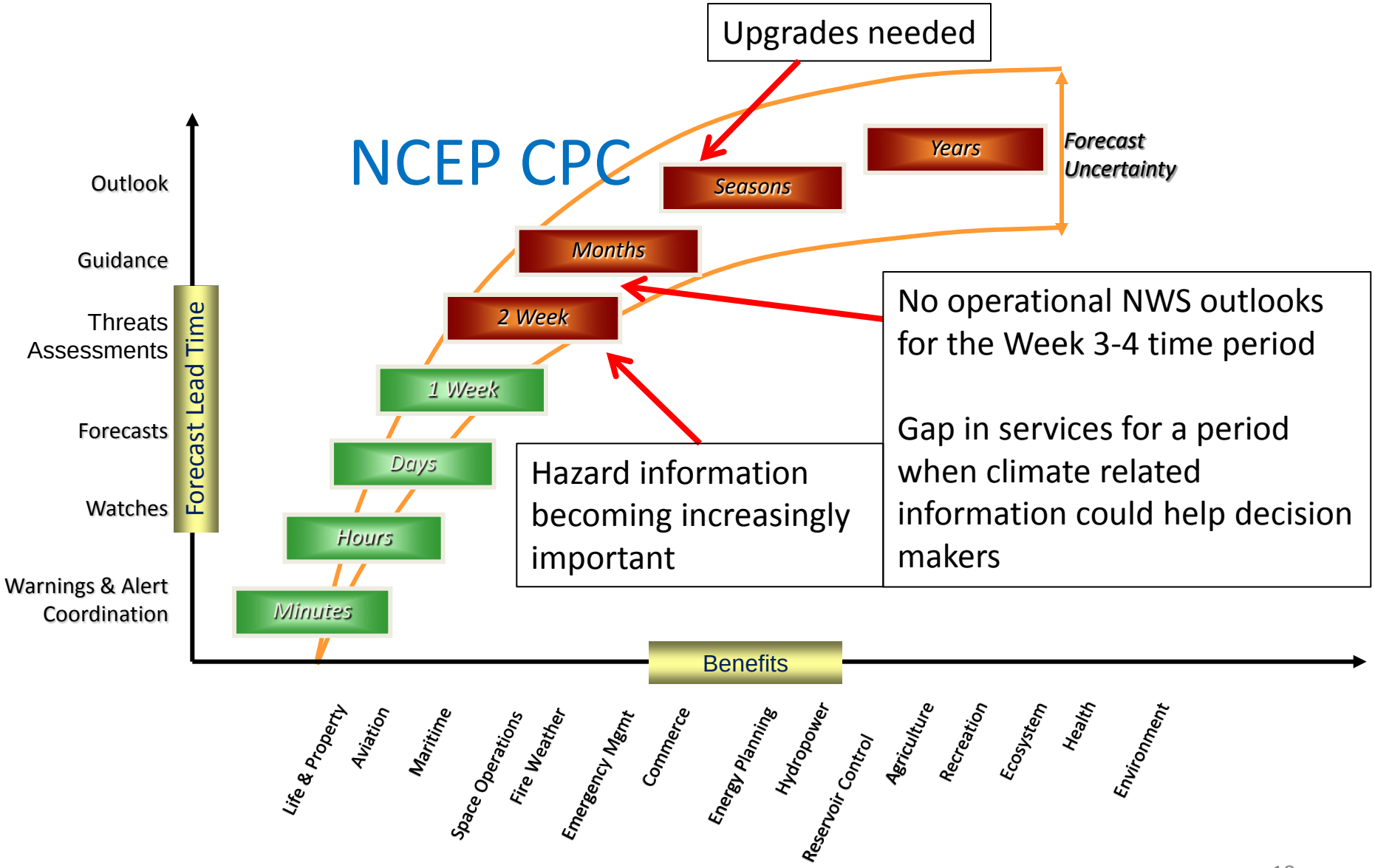
POE Calculator



Outline

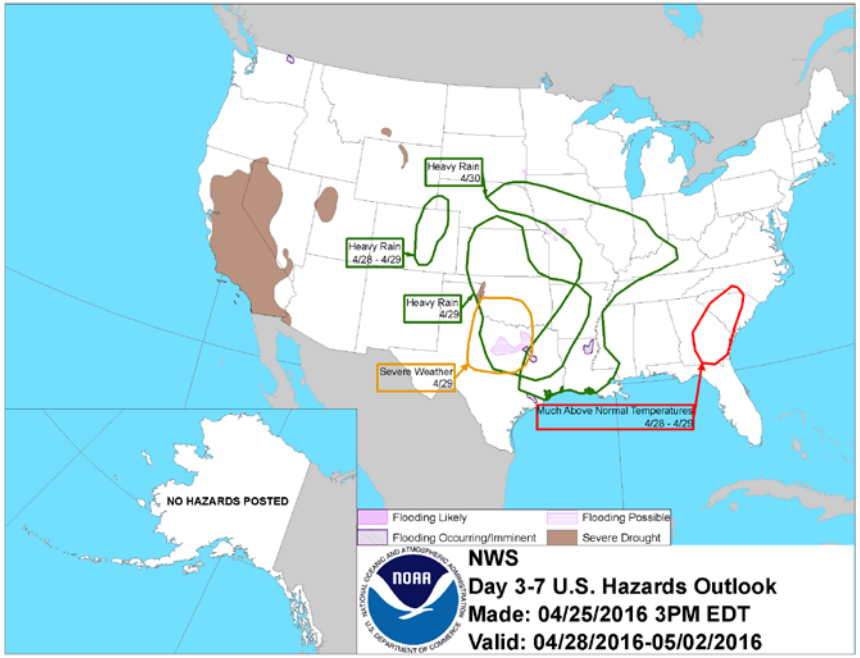
- Brief background
- Towards a Probabilistic Week-2 U.S. Hazards Outlook
- Experimental Week 3-4 outlooks
- Other activities and recent verification

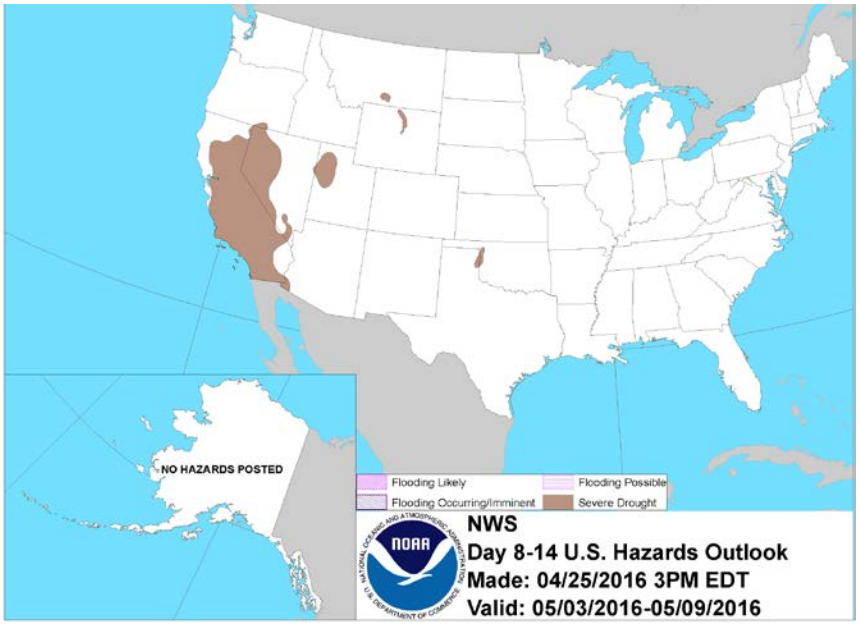
NWS Seamless Suite of Forecast Products



Week-2 Probabilistic Hazards Outlook

Days 3-14 U.S. Hazards Outlook





Due to its deterministic nature in format, tendency to often depict little information during Week-2

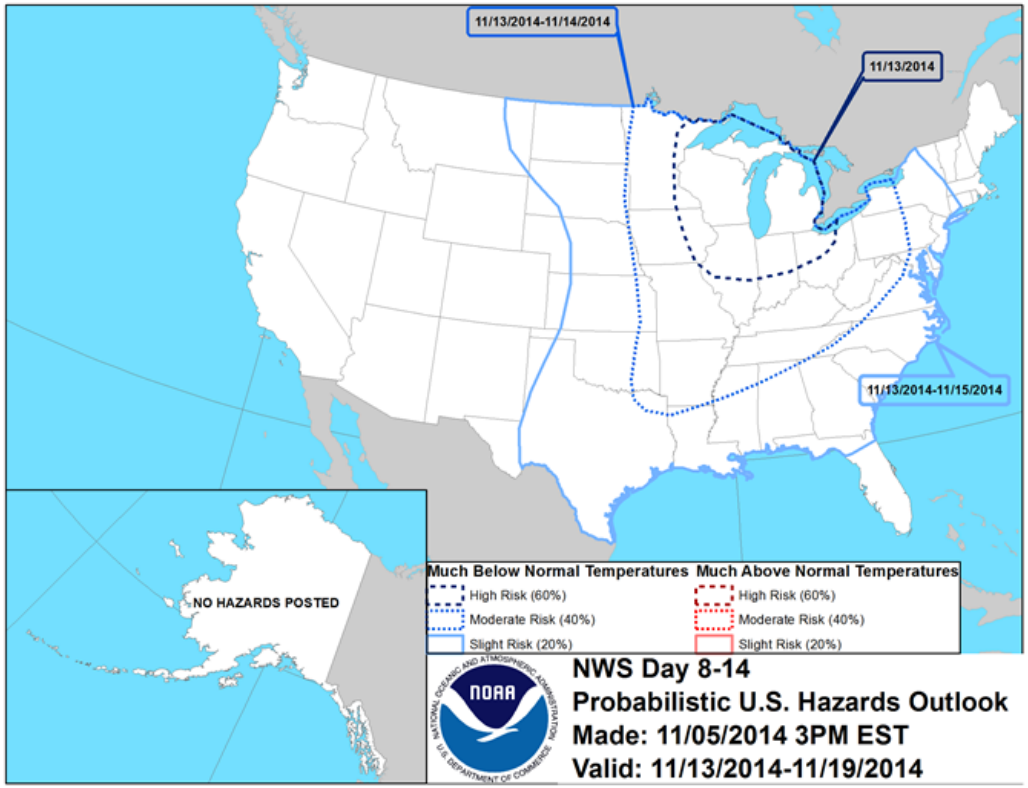
Typical increases in variability and uncertainty in Week-2 led to low forecaster confidence

At odds with CPC's role to provide advanced lead time information

Advance notice for low probability, but potential high impact events

Days 3-7 being transferred to WPC

Probabilistic U.S. Hazards Outlook



Legend

- High Winds
- Significant Waves
- Severe Weather
- Heavy Rain
- Freezing Rain
- Heavy Snow
- Heavy Precipitation
- Much Above Normal Temps
- Much Below Normal Temps
- Excessive Heat
- Flooding Likely
- Flooding
- Flooding Possible
- Enhanced Wildfire Risk
- Severe Drought

Systematically migrating current outlook to probabilistic form

Variable by variable approach

Started with much-above and much below normal temperatures

Anchored by the GEFS Reforecast

Forecaster tool interface allows inspection by various thresholds and percentiles

Experimentally released in July 2014

Probabilistic U.S. Hazards Outlook

- Adding variables to product

Precipitation: Plan is to target total precipitation for the precipitation related category. Work toward including this into the probabilistic product is ongoing during FY16.

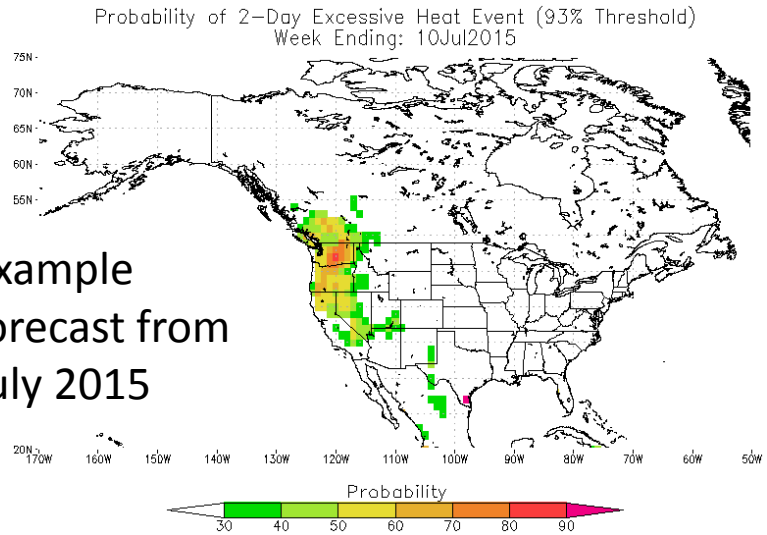
High Winds: Work toward including this into the probabilistic product will be ongoing during FY17.

- Existing criteria/thresholds for hazards may be revisited as part of this process

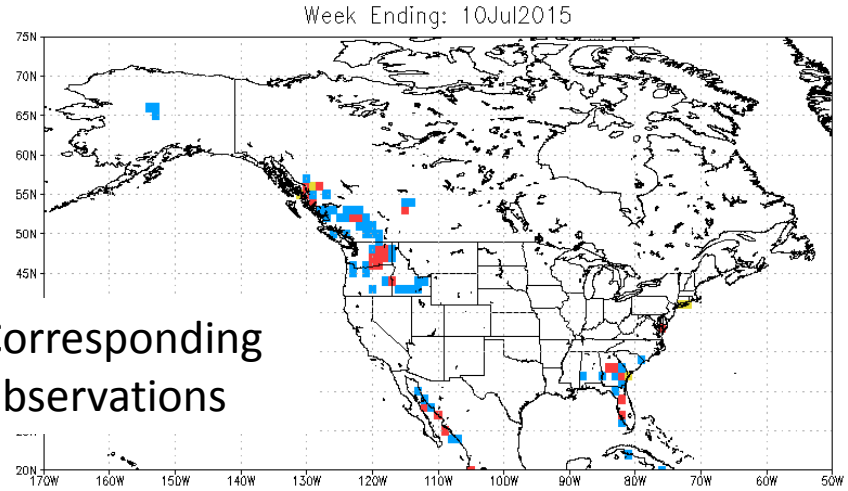
- Not all categories currently depicted on Days 3-7 hazards will be carried over to CPC Week-2 probabilistic product

Probabilistic U.S. Hazards Outlook

Excessive heat event forecast tools



Example forecast from July 2015

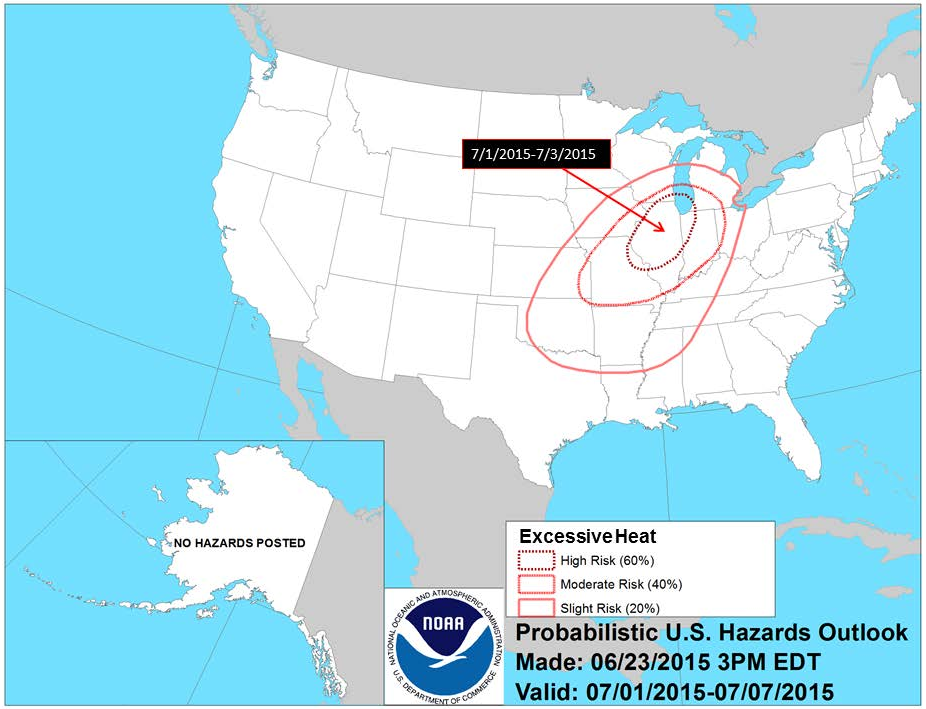


Corresponding observations

- Development of an initial prototype subseasonal excessive heat event outlook system (SEHOS)
- Product depicts the probability of occurrence of heat events during the Week-2 period
- Heat index and percentile based
- Utilizes GEFS and ECMWF real-time and reforecast datasets at the current time
- Internal forecaster review during summer 2016
- Method refinement and model evaluation ongoing

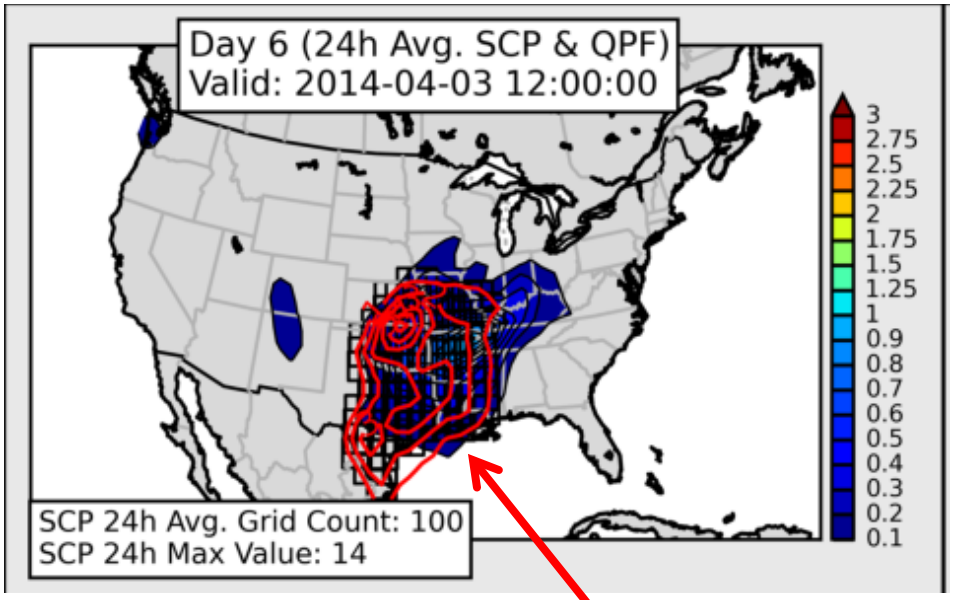
Probabilistic U.S. Hazards Outlook

Will be used to inform the Week-2 U.S. Hazards Outlook



Working with SPC on tools for severe weather potential

Will be used to inform the Week-2 U.S. Hazards Outlook



Supercell Convective Parameter

Experimental Week 3-4 Outlooks

Challenge of Filling the Week 3-4 Gap

The Week 3-4 outlook period is within a time range that:

(1) Primarily no longer benefits from predictability due to atmospheric initial conditions (i.e., Week-2) and

(2) Is at times in a range too short to reliably benefit from slowly evolving parts of the climate system (ocean, land, etc.) known to aid longer time scale prediction (monthly to seasonal outlooks)

- Consequently, the Week 3-4 time range often suffers from low predictability

- Important to understand this limitation to manage expectations

Product Description

- The experimental product is 2-class (above or below-average) temperature and precipitation outlook maps for the favored category of ***two-week*** mean temperature and ***two-week*** total accumulated precipitation

- The target is a combined two week outlook for Weeks 3-4 in the future

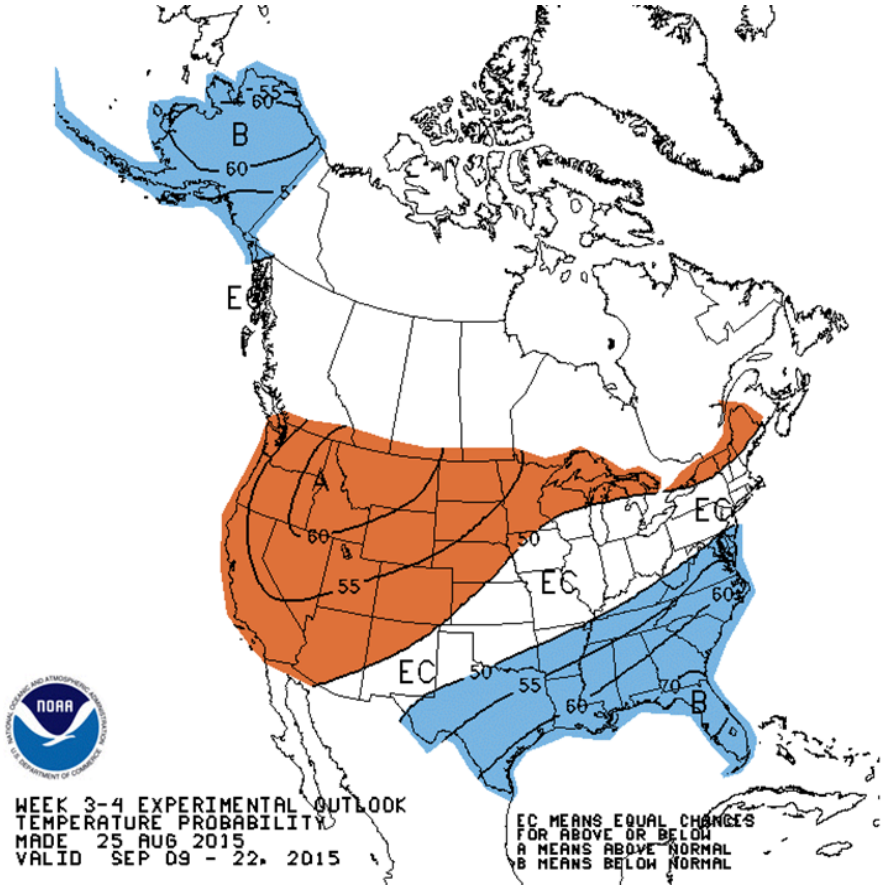
- Outlook maps depict probabilities for the favored category

- The experimental product is released once per week every Friday at approximately 3 PM ET

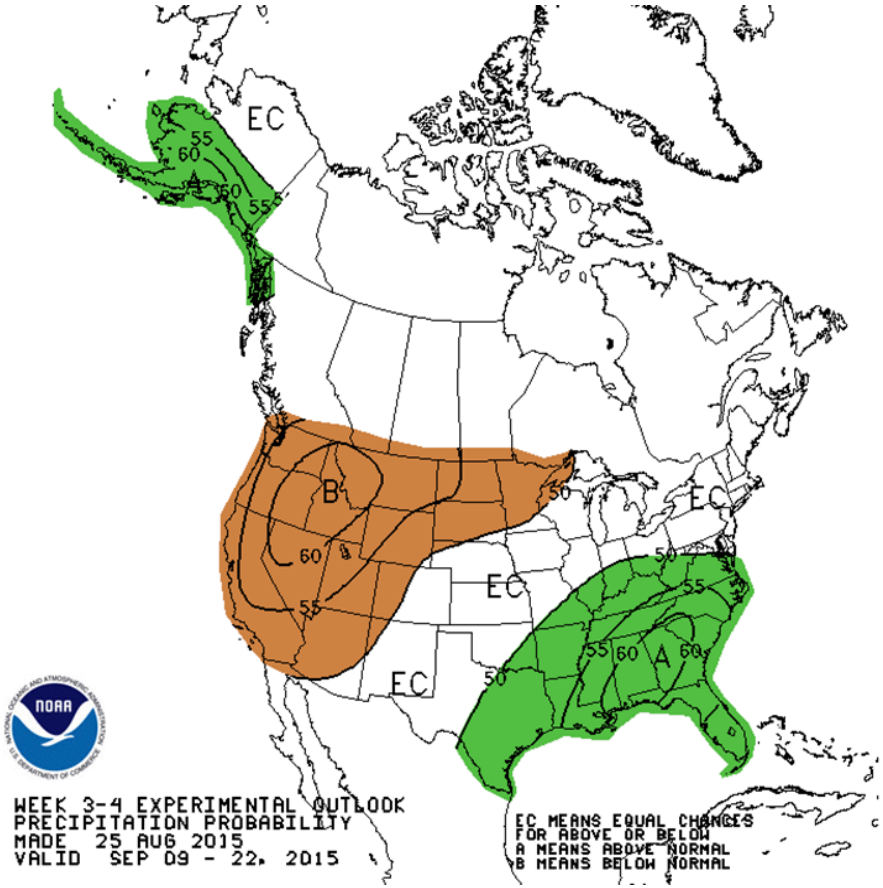
- First experimental outlook was released on September 18, 2015

Experimental Product Format

Temperature



Precipitation



Orange: Above average temperatures favored Blue: Below average temperatures favored Equal Chances (EC): Equal odds for above/below	Green: Above average precipitation favored Brown: Below average precipitation favored Equal Chances (EC): Equal odds for above/below

Why 2-class Outlooks?

- Predictability at the Week 3-4 time range is low and forecast skill marginal given the factors mentioned previously. It was decided that a two category outlook would provide a better opportunity to disseminate useful information.

- CPC has had a longstanding problem with users misinterpreting our more complex tercile class system. For a new experimental outlook, CPC wished to try a more simple type class system to potentially improve upon this situation.

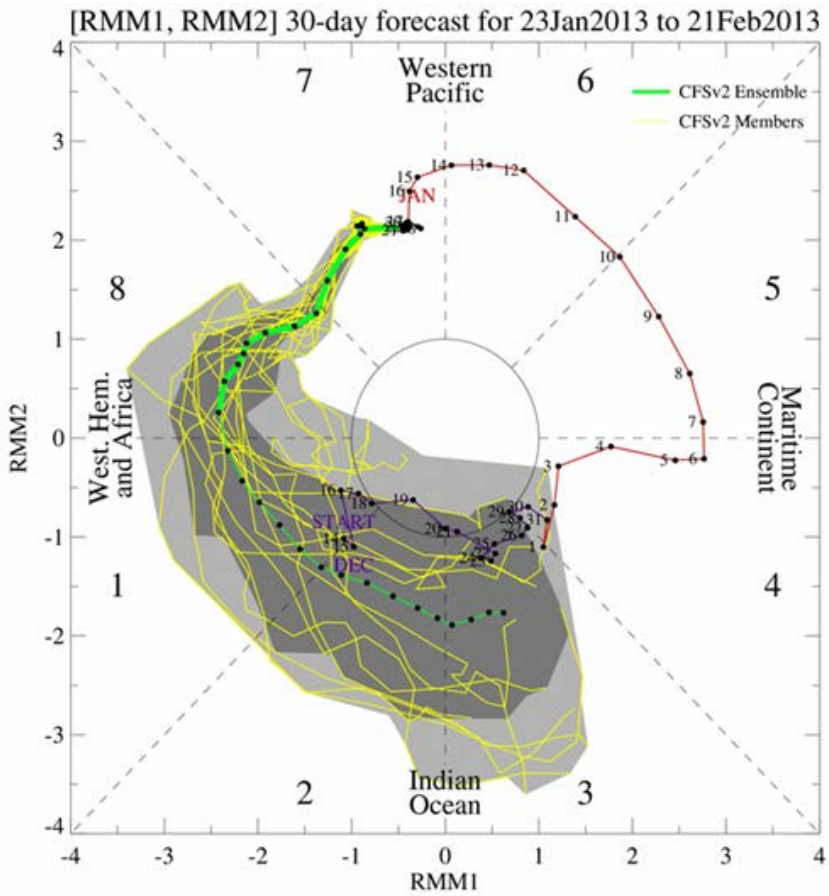
Scientific Basis of Outlook

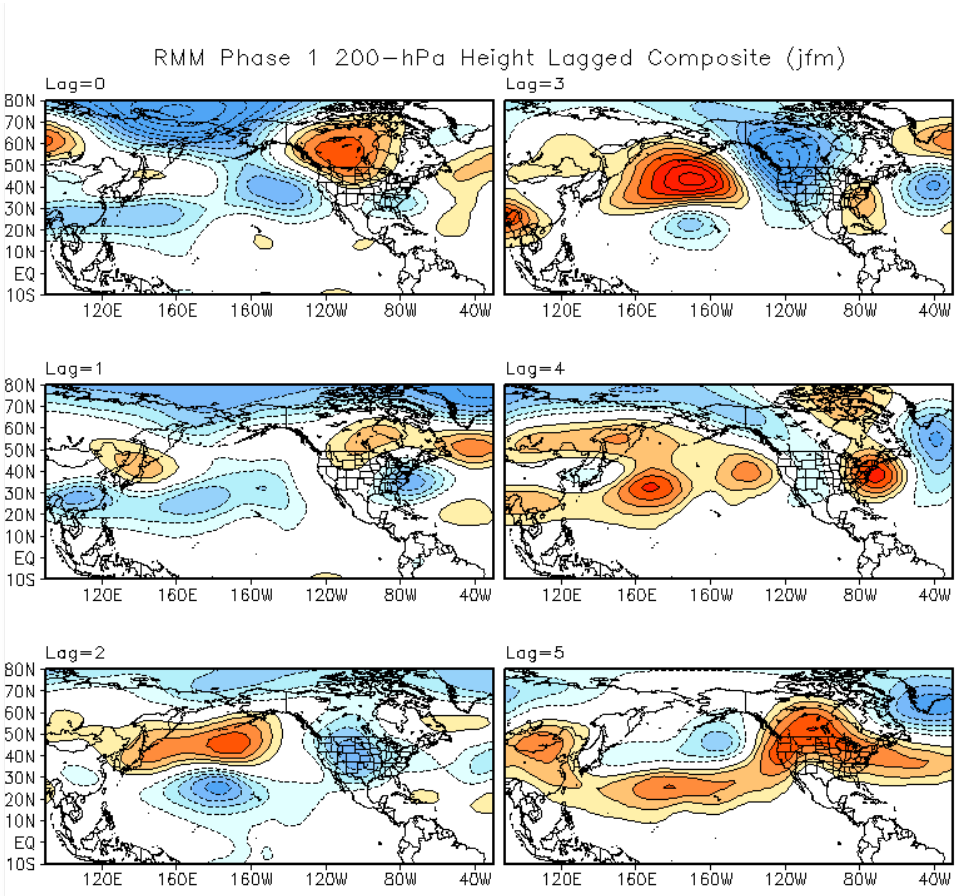
The following factors/tools are considered in preparing the experimental outlooks:

- ✓ El Nino-Southern Oscillation (ENSO)
- ✓ Madden-Julian Oscillation (MJO)
- ✓ Atmospheric blocking (NAO and AO)
- ✓ Bias corrected dynamical model guidance
- ✓ Empirical and statistical tools targeting above climate variability
- ✓ Soil moisture and snow cover anomalies
- ✓ Local sea surface temperature (SST) anomalies

MJO Activity

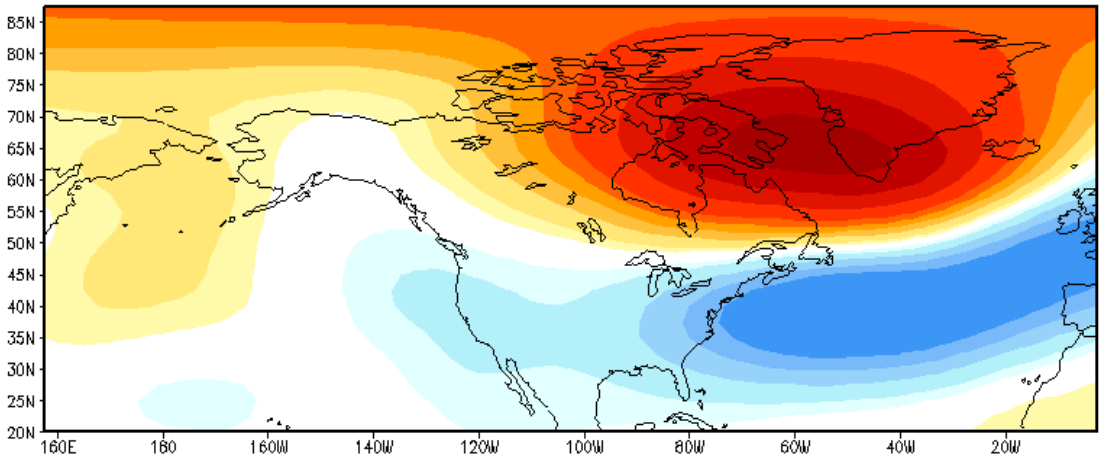
- There are documented relationships between MJO activity (strength and phase) and North America temperature and precipitation patterns

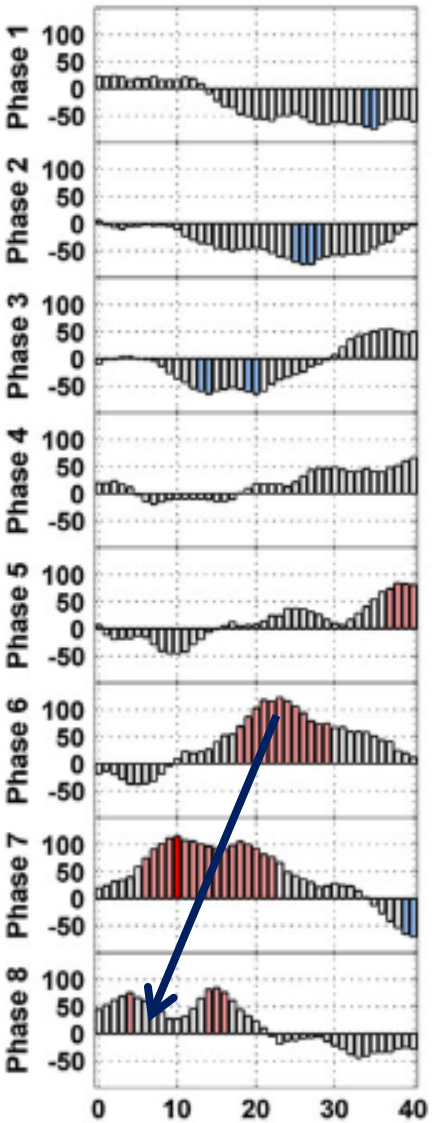




Zhou et al. 2011; Baxter et al. 2014

MJO – NAO/AO Relationships





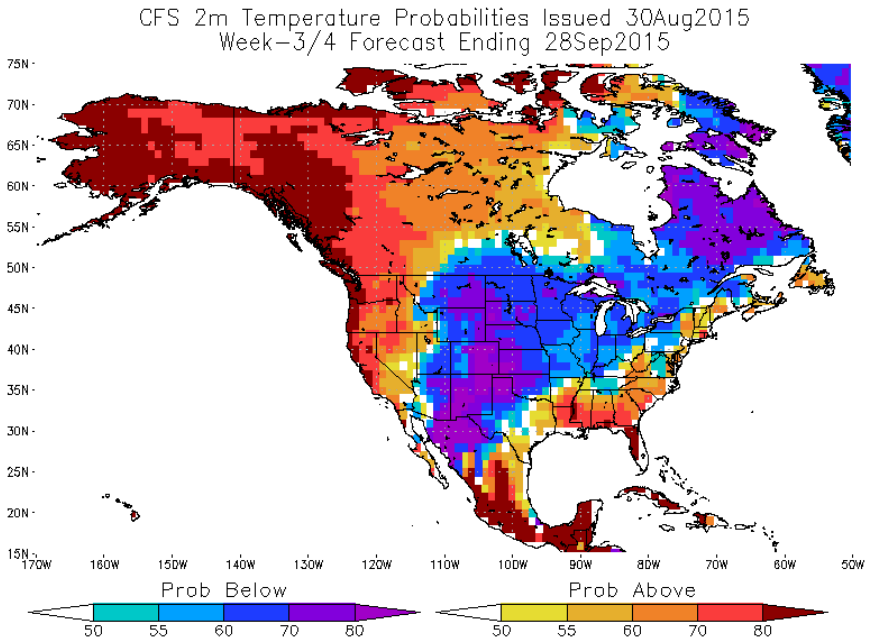
Cluster analysis on 500-hPa geopotential height anomalies

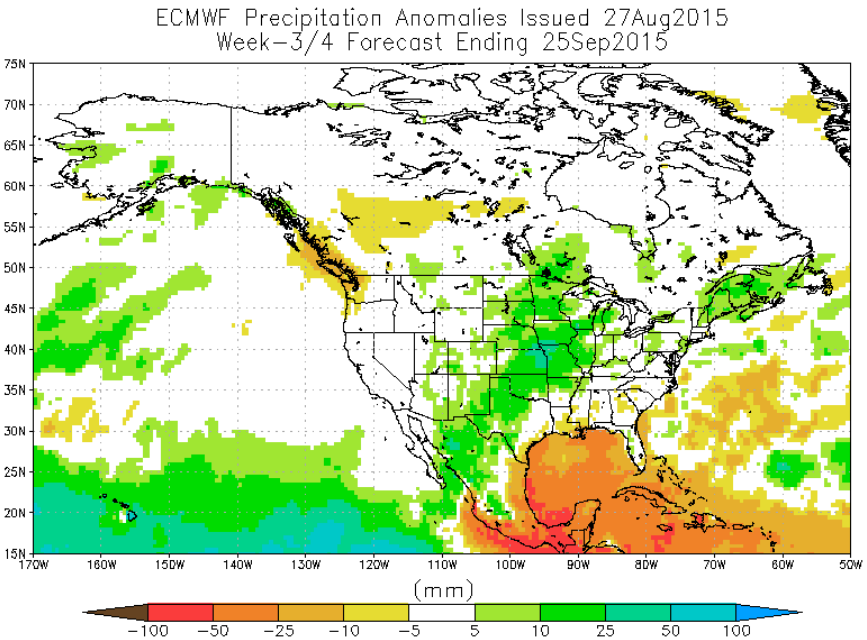
Example cluster resembling –NAO pattern found to occur at above climatological probabilities 10-30 days after MJO phase 6 (right, slanted arrow)

Cassou 2008; L'Heureux and Higgins, 2008; Lin et al. 2009; Riddle et al. 2012

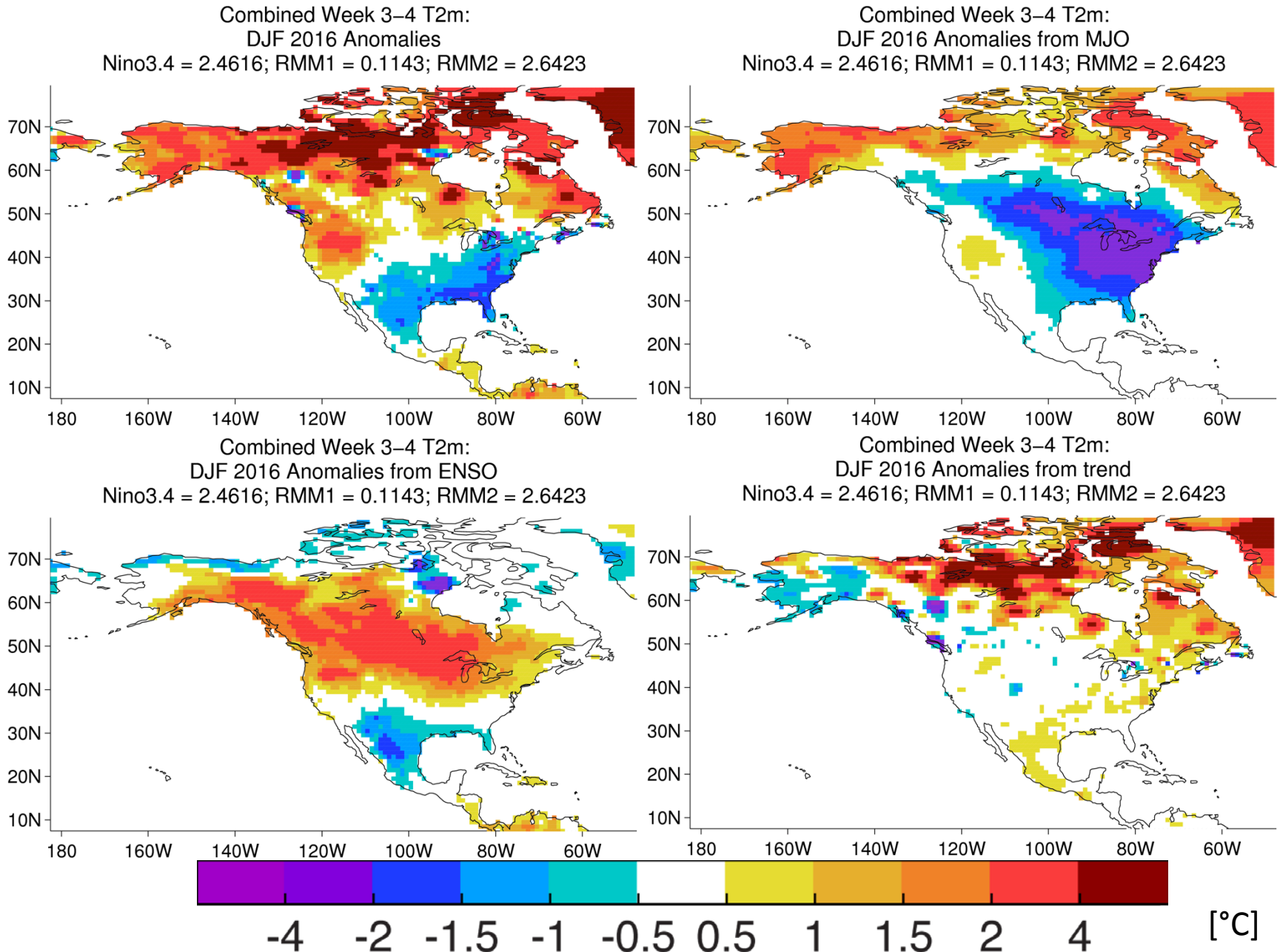
Dynamical Model Forecast Guidance

- Product currently utilizes output from the CFS, ECMWF and JMA
- Model data is bias corrected based on available reforecasts
- A suite of model based forecast tools (500 and 200-hPa height, temperature, precipitation, etc.) is available for the forecaster



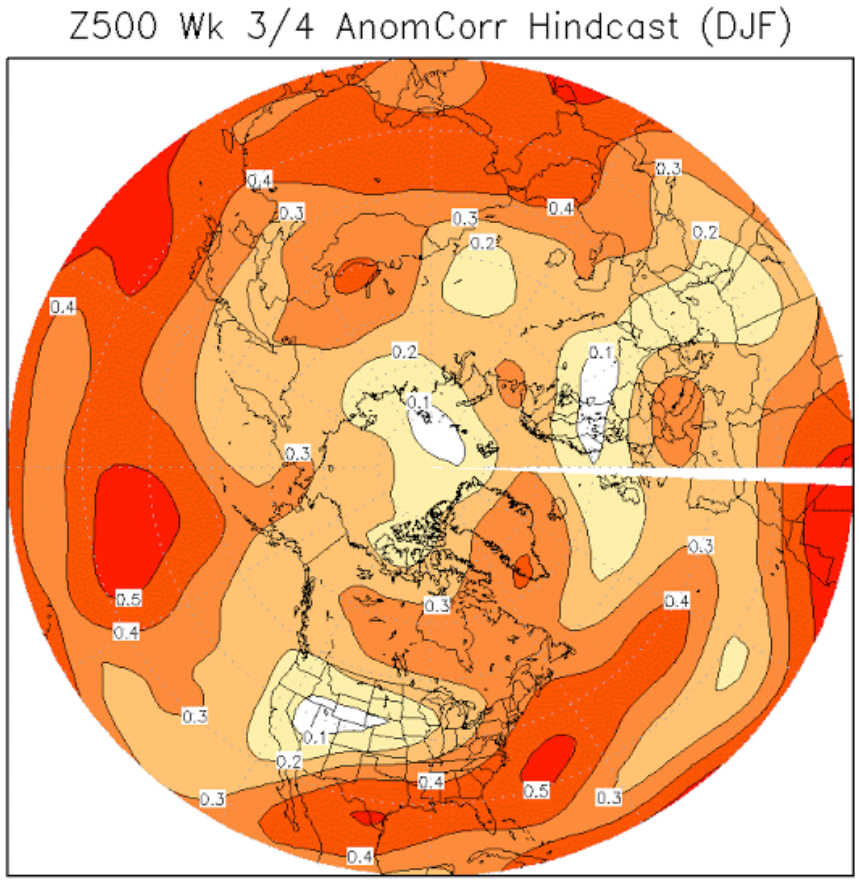


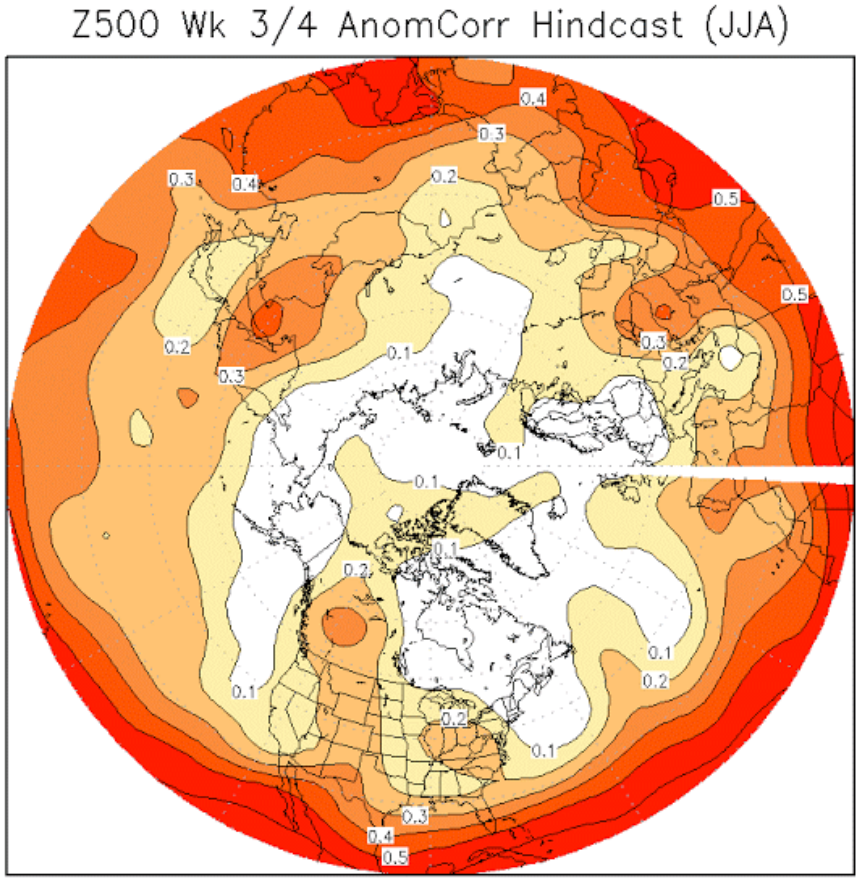
Statistical Forecast Guidance



Retrospective Forecast Skill -- ECMWF

500-hPa Height

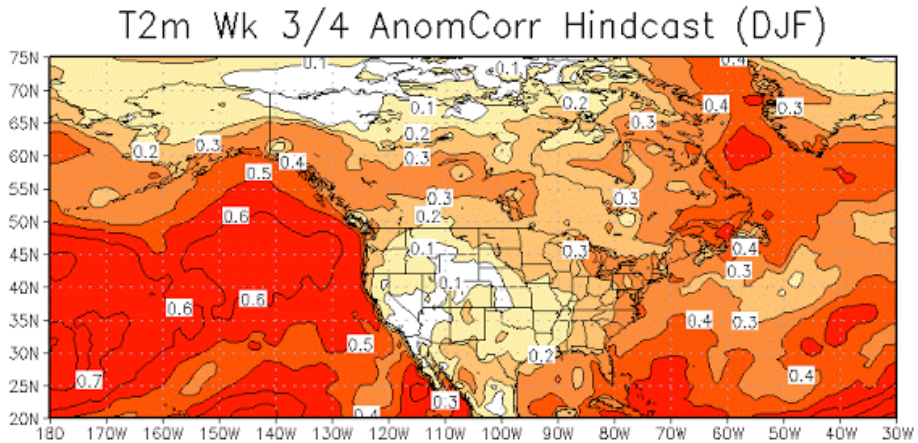


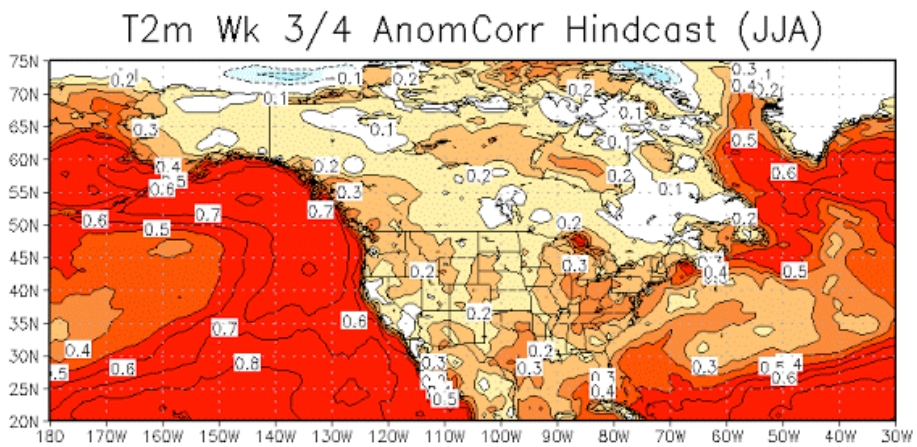


Evaluation Period: 1995-2014

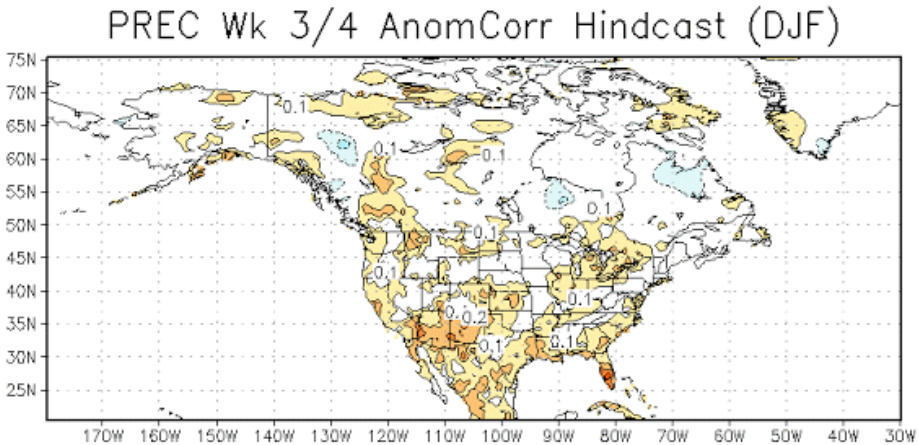
Retrospective Forecast Skill -- ECMWF

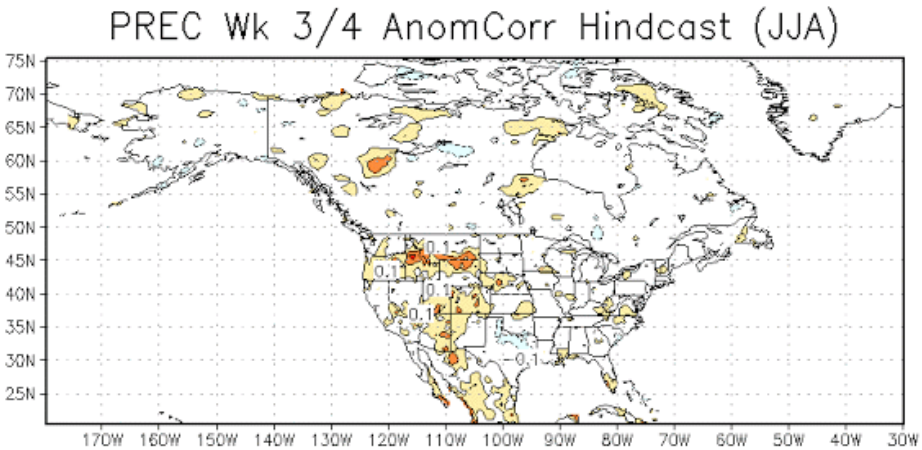
Temperature





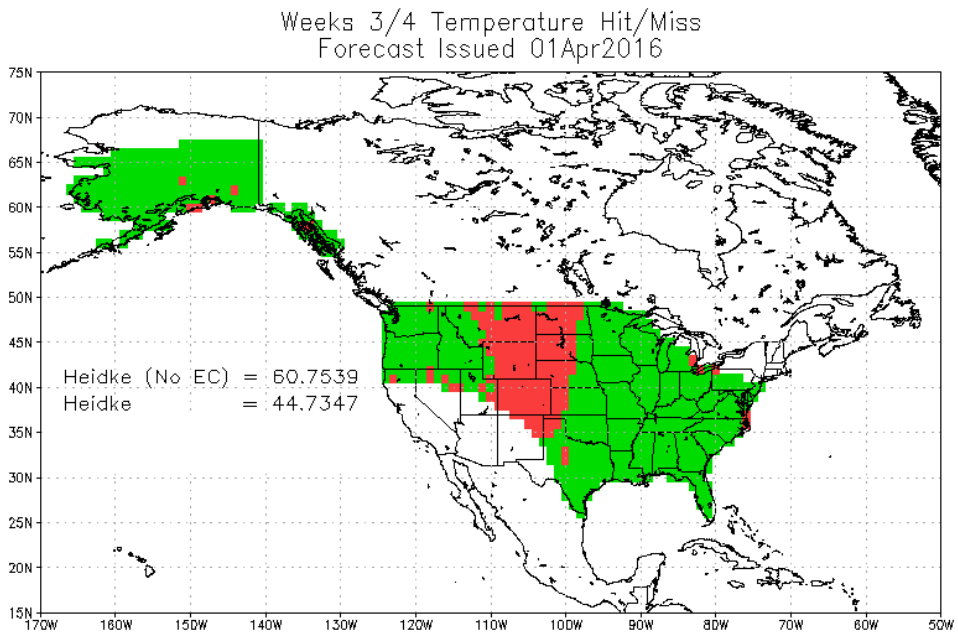
Precipitation





Evaluation Period: 1995-2014

Skill Score Description



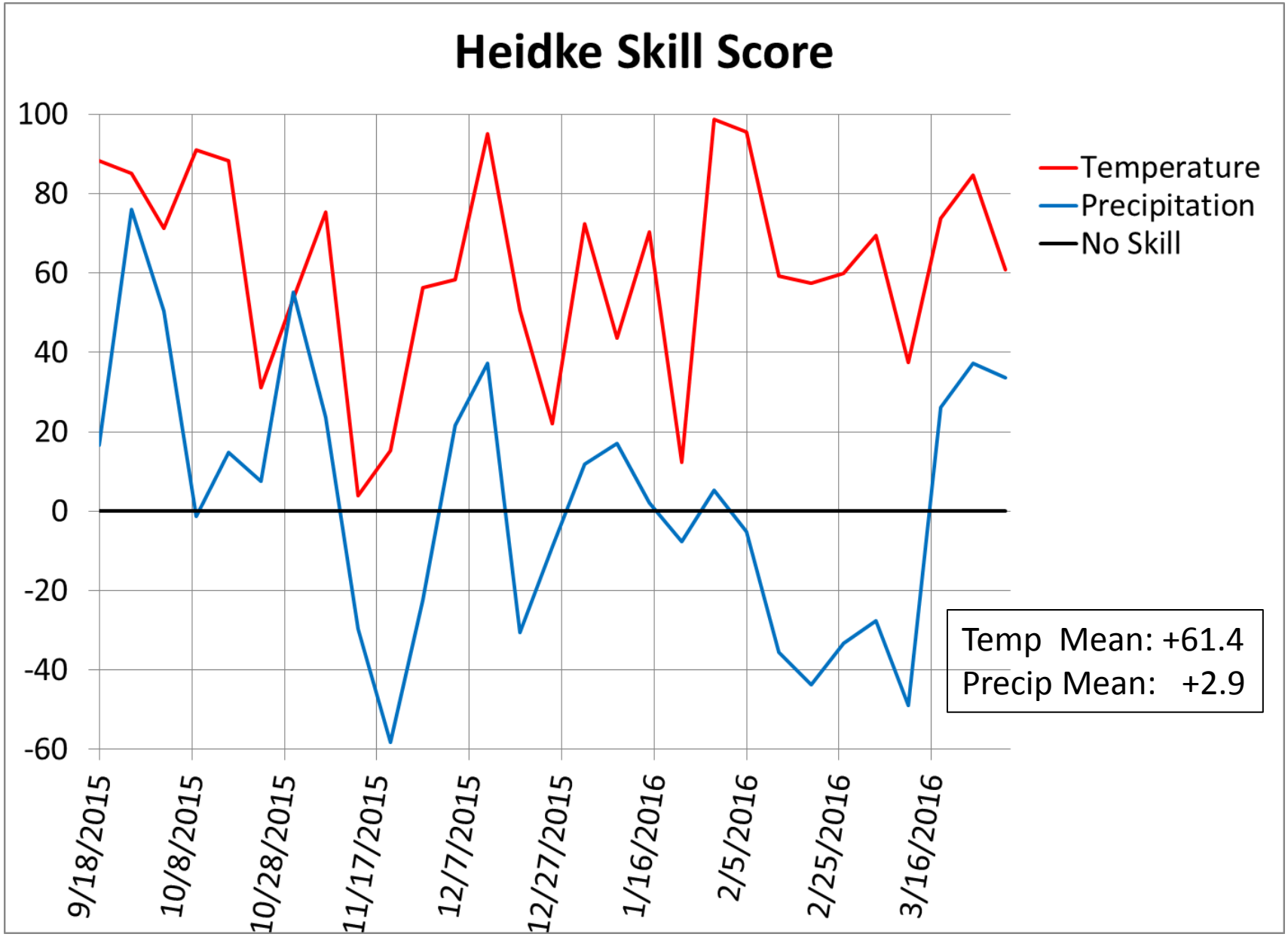
- Heidke Skill Score – Hit/miss based skill metric

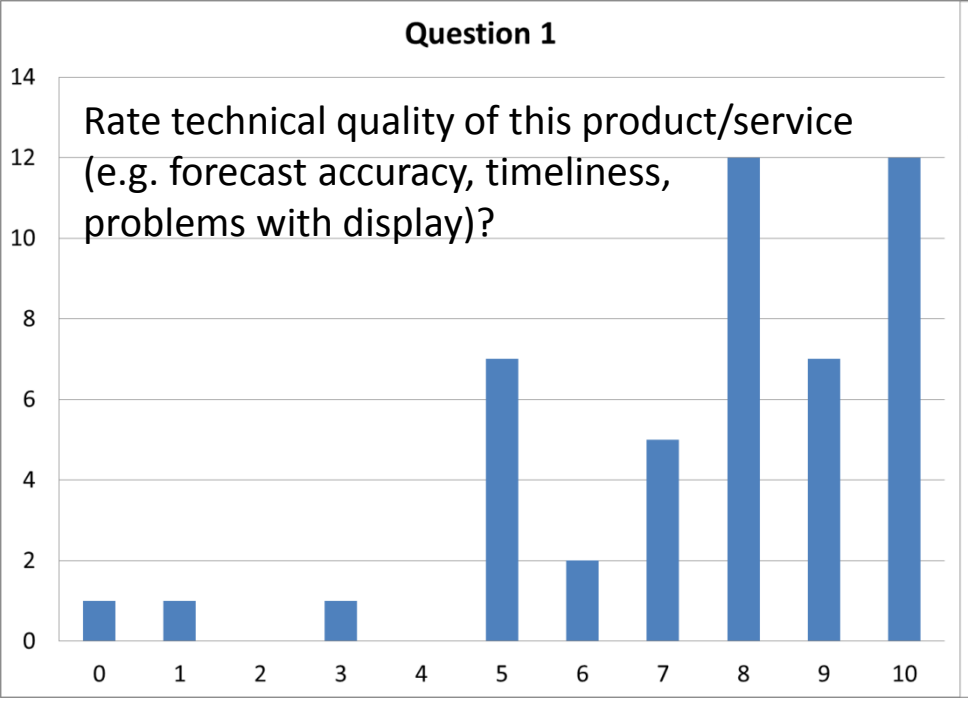
$$HSS = \frac{C - \epsilon}{T - \epsilon} * (100)$$

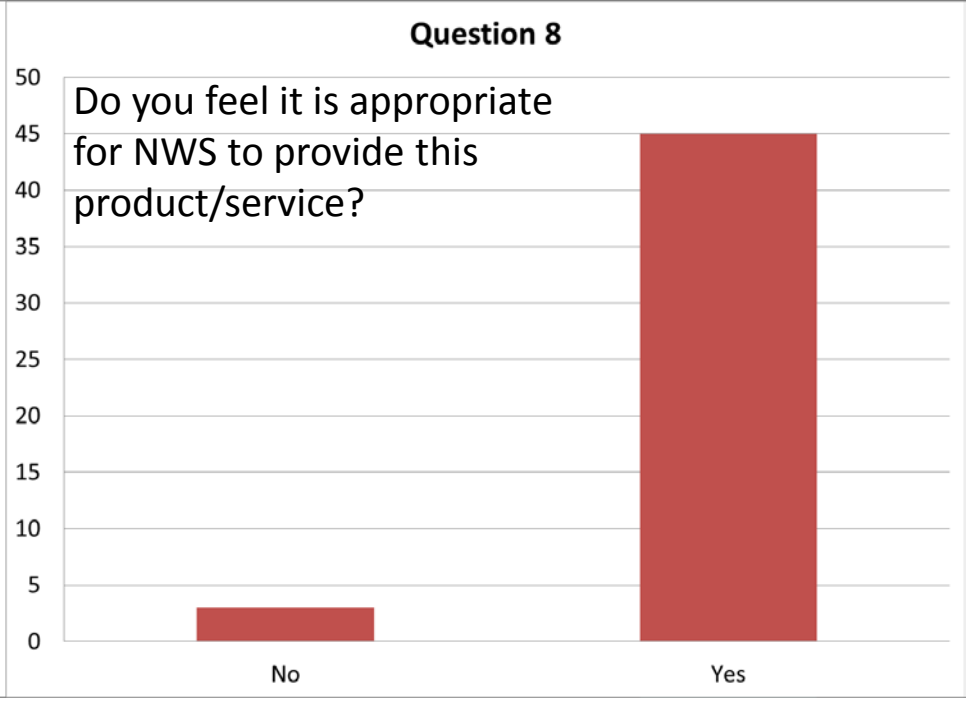
-100 **0** **+100**

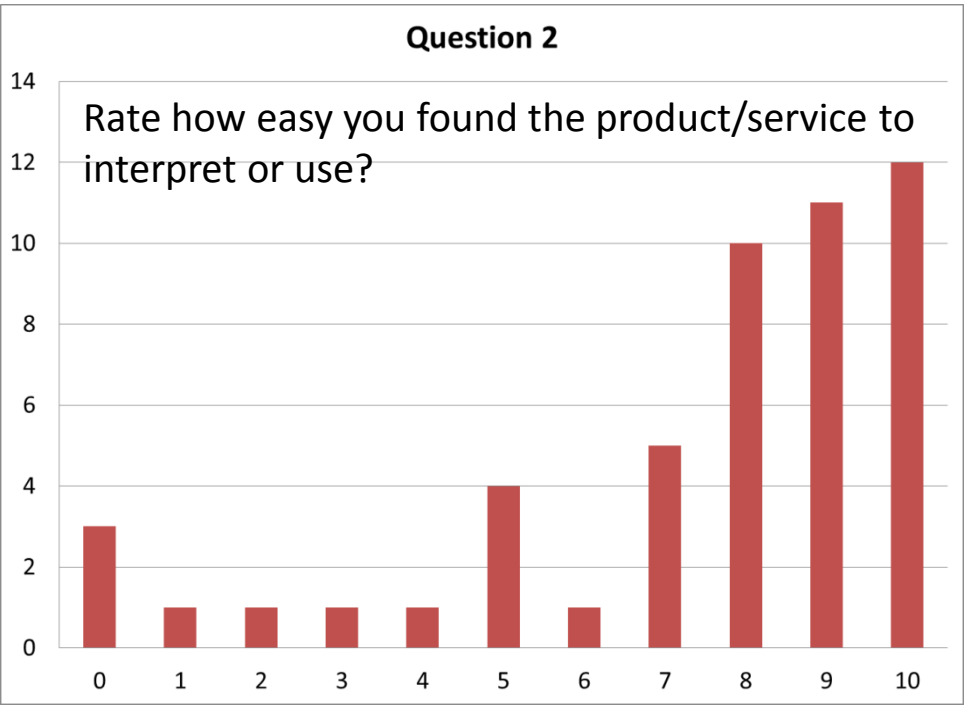
- Positive values indicate forecast skill over that expected by chance
- Zero or negative values demonstrates no forecast skill

Verification to Date




Question 1
Rate technical quality of this product/service (e.g. forecast accuracy, timeliness, problems with display)?
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10


Question 8
Do you feel it is appropriate for NWS to provide this product/service?
50
45
40
35
30
25
20
15
10
5
0
No
Yes


Question 2
Rate how easy you found the product/service to interpret or use?
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10

Other Activities and Recent Verification

Seasonal Outlook Activities

- Organization of an internal Working Group (WG) focused on reviewing seasonal outlook empirical forecast tools

  - ➔ Potentially removing some outdated forecast tools
  - ➔ Upgrading some tools with state of the art datasets or adjusted methods
  - ➔ Producing new information for forecaster from some existing forecast tools
  - ➔ Explore potential new statistical forecast tools

- Exploring the potential for seasonal snowfall forecasts

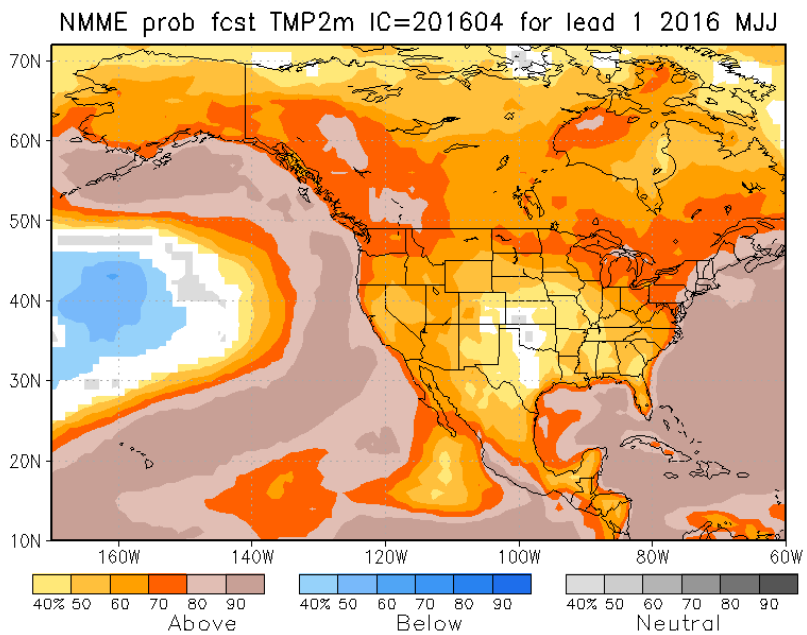
  - ➔ Reviewing and analyzing the scientific basis for such outlooks
  - ➔ Outlining a potential strategy for development of such outlooks

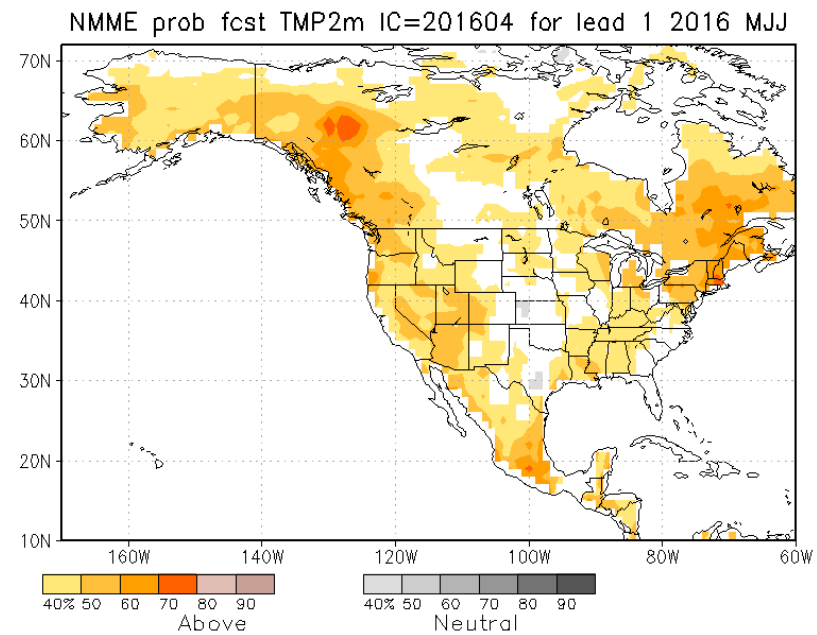
- Exploring the potential and requirements to work towards probabilistic drought outlooks

Seasonal Outlook Activities

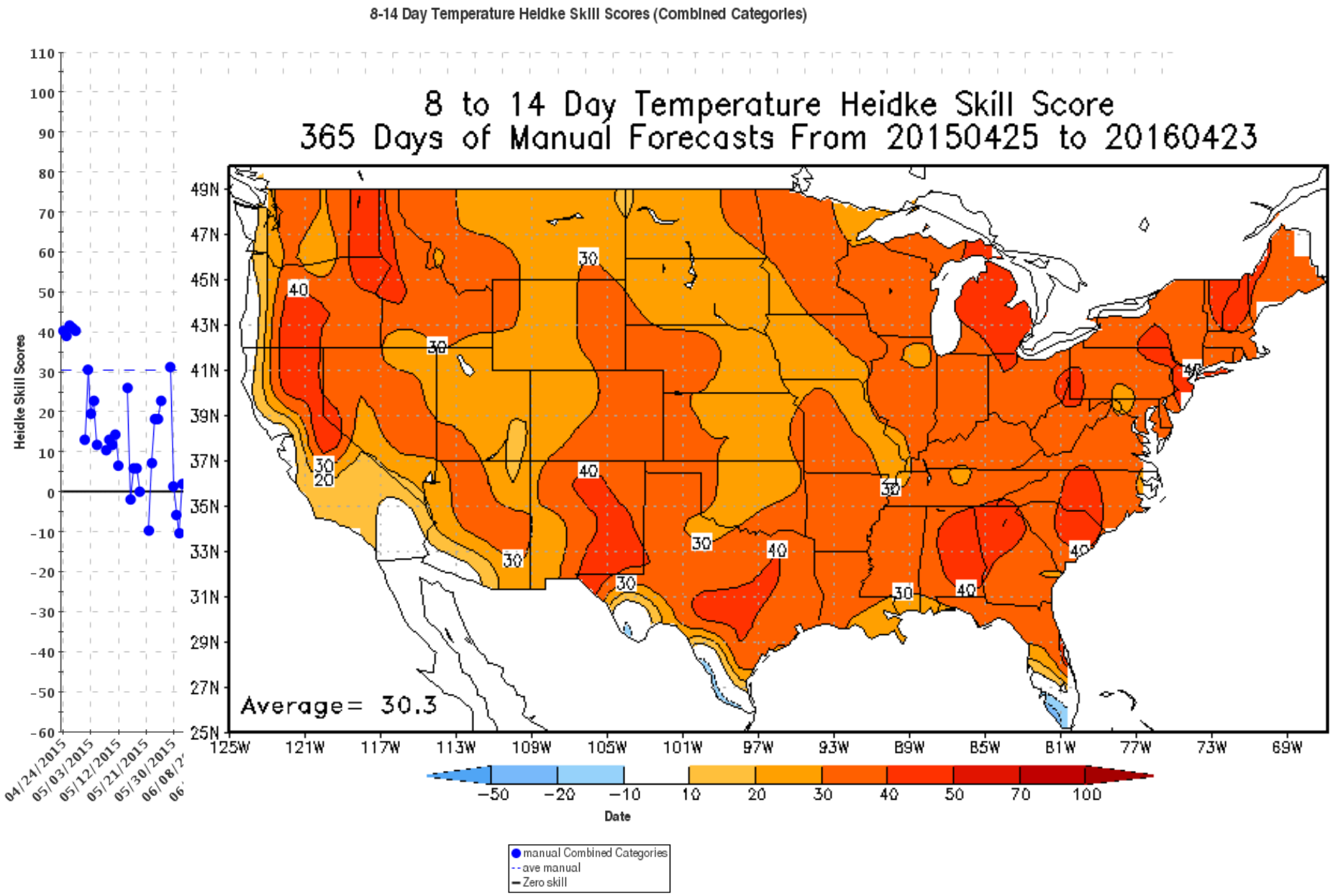
- Organization of an internal North American Multi-Model Ensemble (NMME) Working Group (WG) focused on increasing utility of these dynamical model forecasts

➔ Development of calibrated probabilities based on historical forecast skill
➔ Explore options for non-equal weights in model combination strategies
➔ Additional evaluation studies

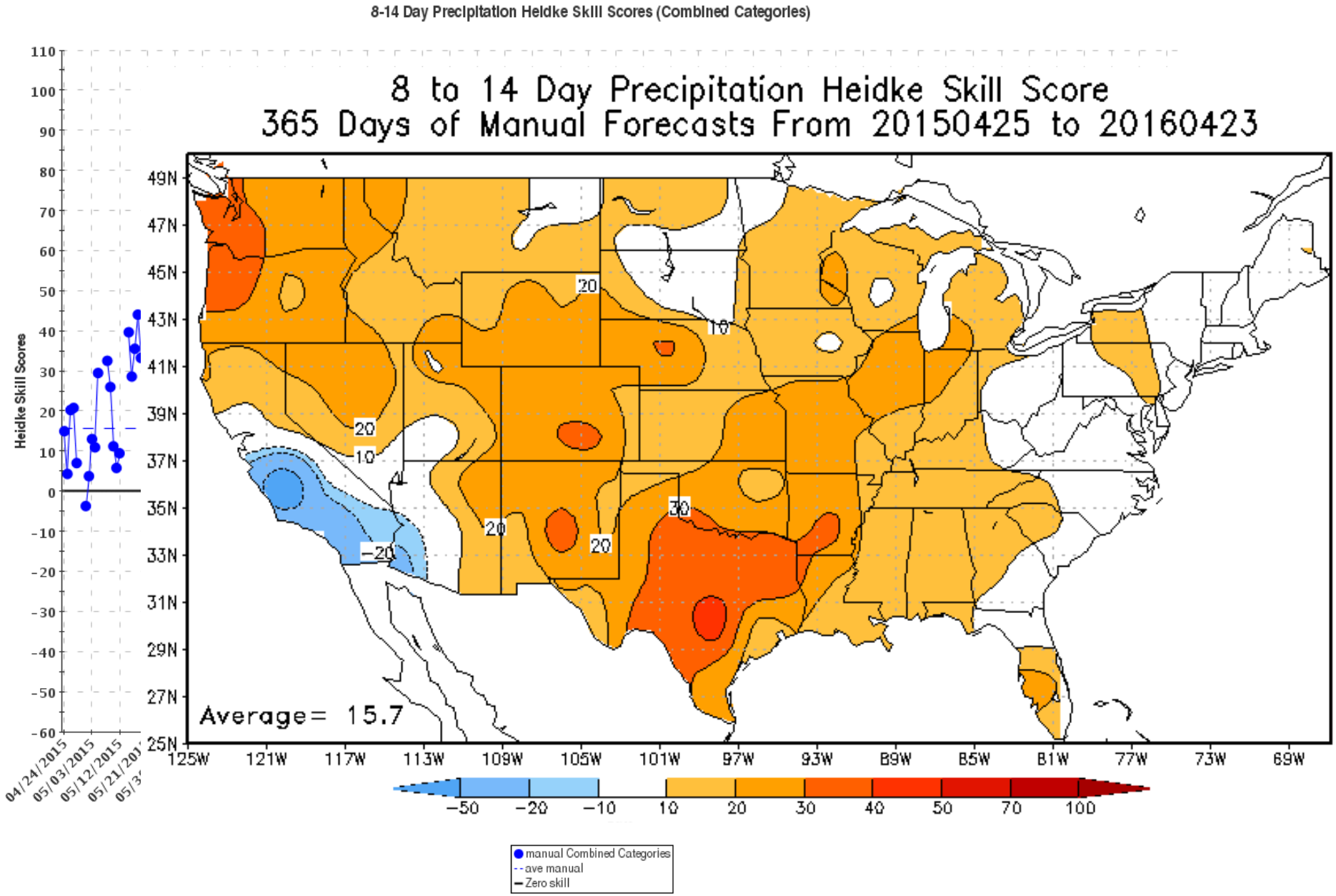




Days 8-14 Temperature Verification



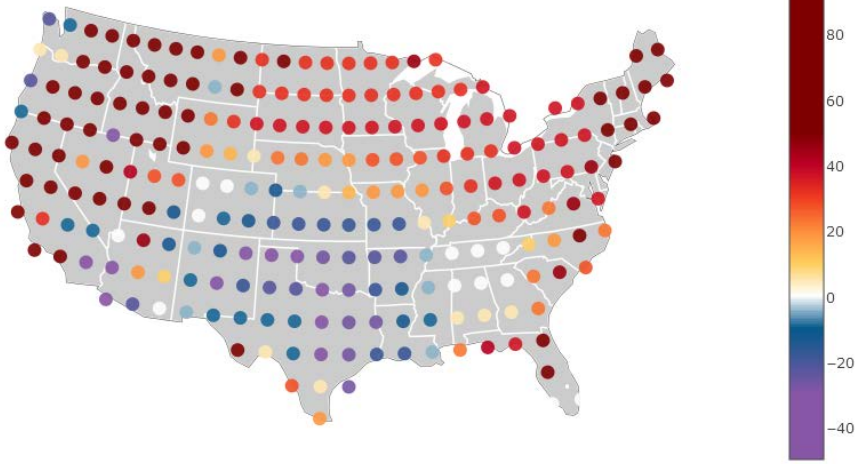
Days 8-14 Precipitation Verification



Seasonal Verification

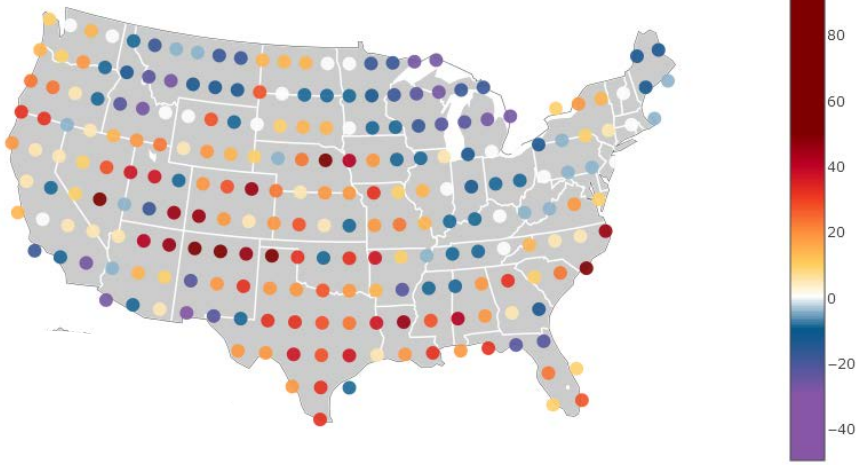
Temperature

Mar-Apr-May 2015 – Feb-Mar-Apr 2016

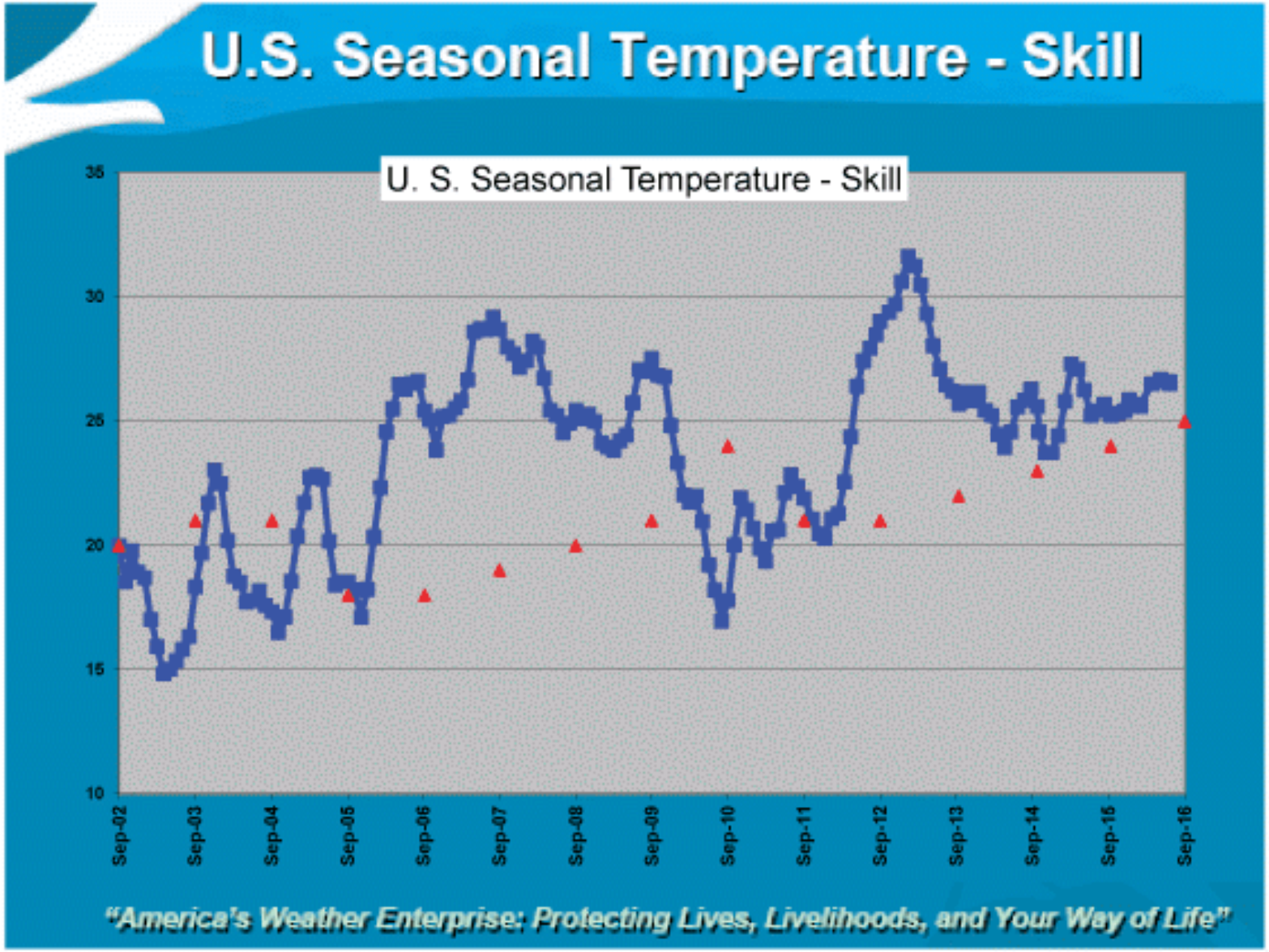


Precipitation

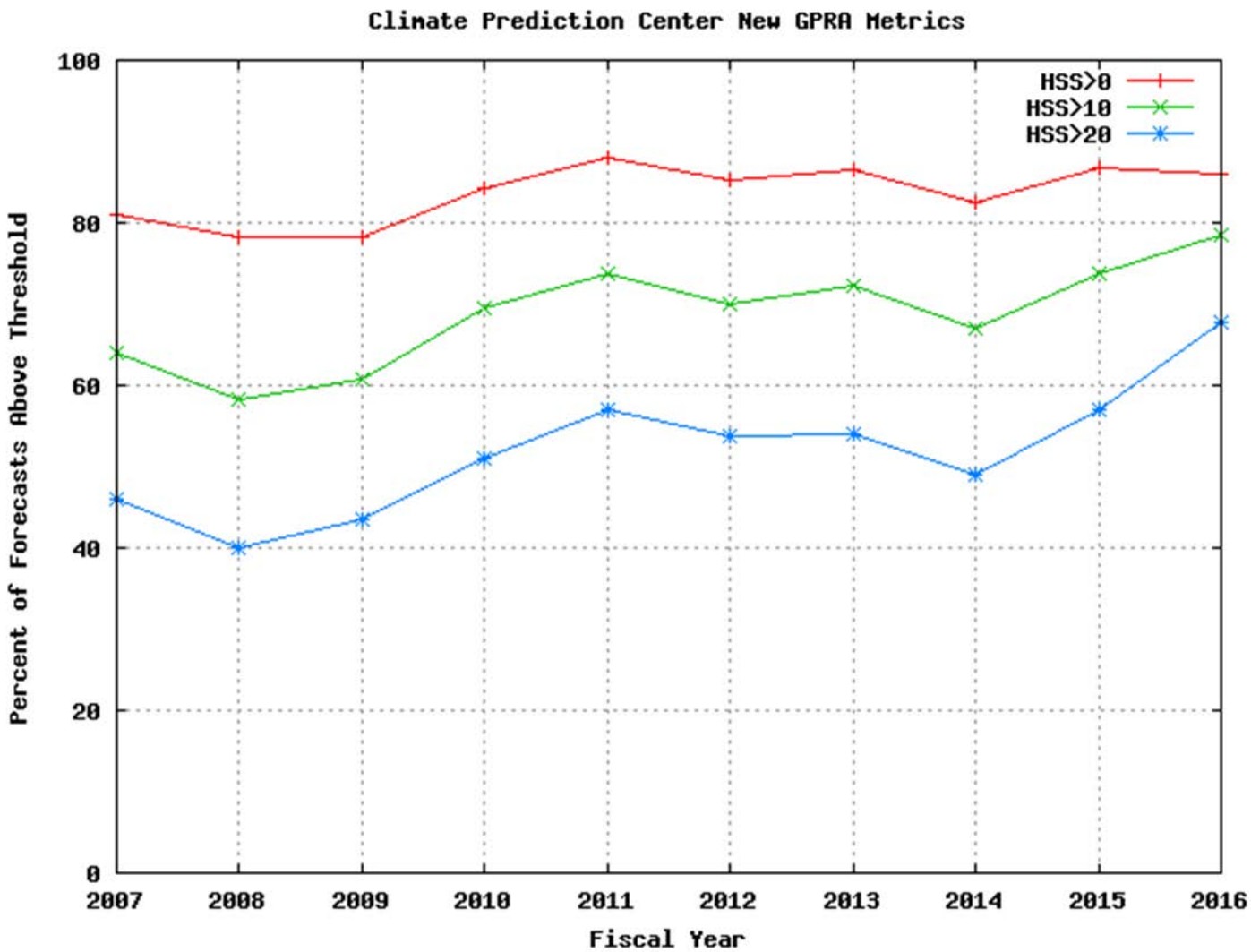
Mar-Apr-May 2015 – Feb-Mar-Apr 2016



GPRA Metric


U.S. Seasonal Temperature - Skill
U. S. Seasonal Temperature - Skill
35
30
25
20
15
10
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
Sep-16
"America's Weather Enterprise: Protecting Lives, Livelihoods, and Your Way of Life"

Additional Experimental Metric



Verification Web Tool

CPC Verification Web Tool (VWT)

This is an interactive tool that allows users to calculate the skill of forecasts, which is a relative measure of how the forecasts performed. Knowledge of forecast skill can help users when using forecasts for decision making.

Instructions for use:

1. Select type of skill score output display desired ("Chart" or "Map").
2. Select Forecast and Verification Options.
3. For "Chart", select region(s) to verify ("Climate Regions","States","Climate Divisions"). For "Map", select dates(s) to verify ("Date Range","Months/Seasons & Years","Climate Phenomena").
4. Click the "Get Scores" button.

Click here for more information

Chart | Map | Tutorial

Scroll down the page to see the results, error messages, and information panel.

1 Options

Forecast options

Field [?] temperature
Period [?] 6-10 Day Period
Lead time [?] 8 days
Data format [?] station
Forecast(s) (Select up to 4) [?] CPC Official (Manual), CPC Official (Auto)
Select forecast models

Verification options

Start date [?] YYYYMMD
End date [?] YYYYMMD
Region(s) [?] CONUS
Skill Score [?] heidke
Forecast categories [?] (*available soon*) include all

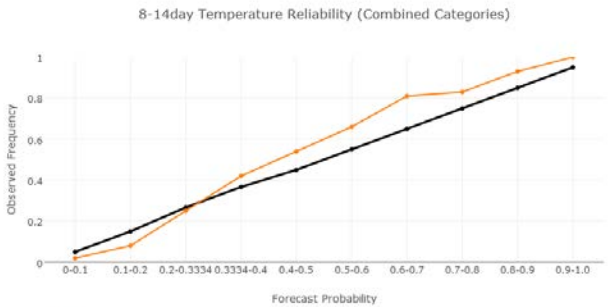
Get scores

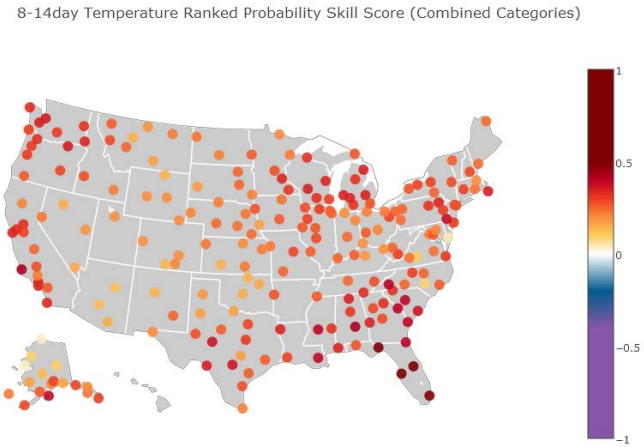
Climate Regions | States | Climate Divisions

2 Select region(s) to verify

To unselect, you must clear all regions by clicking "Revert to CONUS". All regions within the CONUS are verified by default.

Revert to CONUS





http://www.vwt.ncep.noaa.gov/

Thank you for your attention

Comments, questions or suggestions?